Geological aspects of the voyage of HMS *Investigator* in Australian Waters, 1801–5

T. G. Vallance

Department of Geology and Geophysics, University of Sydney, Sydney, New South Wales 2006, Australia

D. T. Moore

Department of Mineralogy, British Museum (Natural History), Cromwell Road, London SW7 5BD

Contents

Synopsis

The voyage of HMS *Investigator* (1801–5) is remembered by natural scientists chiefly for the botanical work of Robert Brown. That there was even a subsidiary effort directed to mineralogy or geology owes much to the enthusiasm of the commander, Matthew Flinders, R.N., and little to the Admiralty's scientific adviser, Sir Joseph Banks. The geological collections made during the expedition to Australia are used here as a key to elucidating a neglected aspect of this venture. What remains of the collections, after 171 years in the keeping of the British Museum (where they constitute the oldest expedition collection of rocks from any part of the world), has now been set in order and related to the records of the expedition. If the geological achievement lies principally in what at the time was called *mineral geography*, at least Brown's discoveries of fossils led to pioneering work in the stratigraphy of Australia. In general, however, the later record is one of sorry neglect. Through ignorance of Brown's collection, for instance, the manganese deposits he found in northern Australia during 1803 have had to be rediscovered during the present century.

Prelude

Among hydrographers and botanists the voyage of HMS *Investigator* is justly renowned. Achievements in these fields have united with the remarkable conjunction of resource, courage and misfortune that marked the command of Matthew Flinders (1774–1814) to fascinate later generations. The expedition had been despatched to further the interests of maritime survey and natural history but, as one finds in the instructions (Flinders, 1814, **1**, pp 8–12) issued by the Lords Commissioner of the Admiralty, the latter department was narrowly conceived. Those instructions refer in some detail to the botanical duties of a naturalist and a gardener. One of the two artists assigned to the expedition was a botanical painter. Nothing is said in the instructions

Bull. Br. Mus. nat. Hist. (hist. Ser.) **10** (1): 1–43 Issued 28 January 1982

about a 'practical miner' who, with a landscape painter, completed the civilian party. What could a miner contribute to a botanical survey, if that were intended? The record of the expedition, both in its planning and execution, shows botany to have been the aim of Sir Joseph Banks (1743–1820), to whom the Admiralty turned for advice in science. Banks imposed his own interests but others, not least Flinders himself, had made representations in favour of bringing geological effort within the scope of the voyage. The practical miner seems to have been Banks's answer, an answer that demanded invention of a role for the man and which, in turn, betrays the limits of Banksian vision in science. Yet there was a geological side to the voyage. In this study we examine a neglected field, relying chiefly on contemporary documents and collections.

The commissioners' failure to express a geological interest, no matter what the reason, contrasts strangely with earlier practice. More than a century before, knowledge of the great mineral treasures yielded by Africa and South America had brought many Europeans to believe that all southern lands were similarly endowed. William Dampier (1652–1715), the first English captain to visit what the Dutch called New Holland, held such views and returned there at the behest of the Admiralty in 1699. He may not have found anything to encourage the notion that the land abounded in valuable minerals (Dampier, 1703, p. 138) but hope persisted. James Cook (1728–1779) was advised to look out for precious materials in appropriate latitudes. He carried with him on his first voyage (1768–1771) round the world a set of 'Hints' of a scientific nature, prepared by James Douglas, 14th Earl of Morton (1702–1768), then president of the Royal Society. The hints included a section headed *Minerals & Fossils* (Beaglehole, 1955, pp 518–519). The remarkable R. E. Raspe (1737–1794), with an eye to private advantage, in 1776 set down his geological thoughts (BL Add MS 30262 ff 11–12) for Cook before the last voyage. Even Joseph Banks who, with his private staff, accompanied Cook when the eastern shore of New Holland was found and called New South Wales, was moved to express a passing thought about the mineral potential of New Zealand (Beaglehole, 1962, **1** p. 472; **2** p. 4). In New South Wales he seemed interested only in the plants and animals.

Banks's close interest in Australasia and aspects of its natural history, bred on that voyage with Cook, remained strong. Elected president of the Royal Society in 1778, an office he held for the rest of his life, Banks became a powerful advocate of Australian settlement and exploration. When a penal colony was established at Sydney Cove in 1788 the founding officers were his correspondents, supplying him with specimens, observations and advice. They, and their successors, knew his particular inclination to botany and sought to please so influential a patron.

The remote settlement at Sydney, in its early years, was utterly dependent on supplies brought across uncharted seas. There was a clear and urgent need for a coastal survey but exploration of more than the most local kind lay beyond colonial capacity. By 1795 only some 100 miles of coast north and south of Sydney had been examined and that in no great detail (Flinders, 1814, **1**, p. xcvi). As Flinders was at pains to point out, that year marked something of a change in the pace of survey. It was when he arrived in the colony on the vessel bringing a new colonial governor, John Hunter (1737–1821). Flinders had already been in Australian waters. Some years before, as a junior officer under William Bligh (1754–1817), he had charted part of Adventure Bay, Van Diemen's Land (Tasmania). That visit in 1792 and, in fact, the whole voyage with Bligh, seems to have quickened his interest in geology (Vallance, 1975, p. 23) as well as helped develop an enthusiasm for maritime surveying.

From 1795 until early 1800, Flinders often in company with his friend George Bass (1771–1803) used what vessels could be spared in Sydney, even rowing-boats, to extend the survey of the coasts. Hunter encouraged the effort. He reported progress to Banks but Hunter's pleas for more worthy support for the cause of exploration brought no immediate practical response. Britain was at war and survey-work in remote parts had no priority. Nevertheless Hunter had sown seed in fertile ground. Thanks to his reports Banks knew something of Flinders's enthusiasm and skill in map-making.

Flinders returned to England during August 1800 and lost little time in reporting to Banks. On 6 September he wrote a long letter (Mitchell Lib., Sydney. Banks Paps. **XX**, 59) outlining his work on the coast of New South Wales and how it might be developed. That so much of 'that still extensive country remains either totally unknown, or has been partially examined at a time when

navigation was much less advanced than at present' seemed justification enough for a thorough survey but Flinders also appealed through natural history for Banks's support. The theme Flinders chose to emphasize is revealing:

> Then a person or persons could be accomodated who should examine into the natural productions of this wonderful country, for surely what has already been found is materially different from all others; and the mineralogical branch would probably not be the least interesting.

It was not the first time Banks had been urged to support mineralogical study in Australia. Hunter, writing 1 August 1797 (BM (NH) DTC **10**(2) 108), made a similar point. Some, like a certain Baron Wilhelm von Fürk of Hamburg (Fürk to Banks, 20 Dec. 1801. Mitchell Lib., Sydney. Brabourne Paps. **10**, 331), even offered to go out in the service of mineralogy. And not only Banks at this time heard of the advantages of geological exploration in New South Wales. John Mawe (1764–1829) the mineralogist and dealer prepared a detailed statement for Lord Pelham outlining a plan for a mineralogical expedition to New South Wales (BL Add MS 33124 ff 109–116). The document is undated but the following remarks suggest preparation in 1799 or 1800:

> . . . I was informd it is promulgated to send men to our Colony in New South Wales, if so it will be truly mortifying to see the French publish the Geology of our Settlements &c or working mines in our Colonies, for by thus employing Mineralogists, they [the French] render as it where, a bounty for Discovery . . .

Mawe had been well-informed; a surveying expedition with two vessels and a large staff of scientists, among them two trained mineralogists (Louis Depuch (d. 1803) and J. C. Bailly (1777–1844)), left France for Australia under the command of Nicolas Baudin (1754–1803) in October 1800, before Banks had responded to Flinders' letter. Banks knew details of the French scheme for he had been instrumental in securing issue of a passport for the vessels in case of war.

Banks acted swiftly after meeting Flinders. A plan for an Australian expedition was approved at the Admiralty and sanctioned by the King in a matter of days. Before the end of November 1800 a vessel had been chosen and ordered to be prepared. But the Admiralty left matters scientific to Banks. He determined the botanical flavour. Changes in the ship were made to accommodate more plants, at Banks's direction. If Flinders still hoped to have a mineralogist, and it is interesting to note his letter of 24 January 1801 (*HR NSW*, **4**, 291) advising Banks of modifications to accommodate botanical materials *and* the collections of the mineralogist, Banks clearly had other ideas. There was to be one naturalist and he a botanist.

For the post of naturalist, Banks turned to Robert Brown (1773–1858), then ensign and assistant surgeon with the Fifeshire Fencibles on duty in Ireland (Edwards, 1976). Brown had studied medicine first at Aberdeen and later in Edinburgh where he also attended for two sessions the Natural History Class conducted by John Walker (1731–1803) and in one of them (1792) was a fellow-student with Robert Jameson (1774–1854), eventually Walker's successor. There Brown must have learned something about the Earth and its materials, for Walker had geological interests (Scott, 1966). But it was botanical nature that captivated Brown—and had done so since boyhood.

To assist Brown, a gardener Peter Good (d. 1803), who already had some experience of the care of plants at sea, and a botanical artist Ferdinand Bauer (1760–1826), who likewise had knowledge of expedition-work, were appointed. A landscape painter joined them. He was William Westall (1781–1850), a man destined for modest fame as a watercolourist and rather less as brother-in-law to the Cambridge geologist Adam Sedgwick (1785–1873). Banks responded to the business of a mineralogist by asking William Milnes (1757–1814) of Ashover, agent for the Derbyshire mines in which he had considerable interests, to find a miner willing to join the expedition.

Milnes must have been slow for on 20 January 1801 Banks wrote again urging him to continue the search. The letter reveals what Banks then had in mind:

> The person need not be an able miner, as no trials are intended to be made below the surface.

> All mines in a new country may be seen at the surface. What is expected of the person who will be sent out is that he, under the direction of the naturalist, take specimens of all rocks, and particularly of the contents of all mineral veins he meets with, and brings them home. (*HR NSW*, **4**, p. 291).

He added that the voyage would very likely 'make the fortune of the person who engages in the mineral line' for 'none of the mountains where precious metals are most likely to lie have yet been examined'. If Derbyshire failed to provide the man he wanted he would get one from Cornwall and that 'will be severely reported hereafter'.

Although it has been claimed recently (Harris, 1974) that John Allen, the miner found for the voyage, was a native of Camborne there can be no doubt he came from Derbyshire. Banks mentions him both as 'my Derbyshire friend' (BL Add MS 32439 f 95v) and 'a Derbyshire miner' (BL Add MS 32439 f 237v), Milnes acted as Allen's agent during his absence and, finally, there is Allen's will (Sutro Lib., San Francisco. Banks Paps.) This document names his mother, Elizabeth Allen, and a brother, James, both of Ashover. Searches of the Ashover Parish Registers kindly made for us by Mr S. R. Band of Wingerworth reveal a baptismal entry dated 7 May 1775 for John son of James Allen, Park. Mr Band advises that Park signifies Overton Park, an estate Sir Joseph Banks inherited from his uncle in 1792. The Banksian connexion, Banks's references to the miner in 1801 as a young man and the one John Allen in the baptismal register for the appropriate period lead us to believe he was the man. He would have been aged 26 years, when he sailed with Flinders. We know nothing of Allen's activities before 1801 though the fact that he could write, if in a laboured hand (two letters and other Allen documents are in the collection of the Sutro Library, San Francisco), suggests education beyond that attained by most 'practical' miners at the time. If Allen kept a journal while on the *Investigator* it has not been found; we depend on the records of his colleagues to know what he did.

Banks made it clear the miner was only an assistant; Allen, and Good, were not scientific gentlemen, they were with them. Having the responsibility for directing Allen, Brown probably thought it necessary to enlarge his own geological knowledge. Edwards (1976, p. 388) mentions that Brown received instruction in that subject from a Mr Hawkins. In fact, Hawkins's *Instructions* were preserved by Brown and are now in the British Library; they are printed here for the first time (appendix). The document enables us to identify the writer as John Hawkins (1761–1841), M.A. of Trinity College, Cambridge and one of the first Englishmen to attend (in 1786 and again in 1793) the Bergakademie at Freiberg, Saxony. There he became a friend and admirer of A. G. Werner (1749–1817) the famous teacher of geognosy and exponent of neptunian concepts of earth processes. A fluent linguist, Hawkins had many links with German mineralogists; the distinguished mineral chemist M. H. Klaproth (1743–1817) dedicated the first volume of *Beiträge zur chemischen Kenntnis der Mineralkörper* (1795) to his friend Hawkins. Hawkins, in fact, was an important link in the exchange of information and ideas between British and German science. His achievement is still not widely recognized.

How Hawkins and Brown came together is unknown. Banks may have arranged a meeting (Hawkins, F.R.S. since 1791, was a correspondent of Banks), but a more likely link is Bauer. When offered his post on *Investigator*, Bauer was completing sketches begun while travelling in the eastern Mediterranean region with the Oxford botanist John Sibthorp (1758–1796) and Hawkins. As an executor of his kinsman Sibthorp's will, Hawkins actively promoted completion and publication of Sibthorp's work, not least the famous *Flora Graeca* in ten volumes (1806–1840). The surviving Hawkins–Brown correspondence (B.M. (N.H.) Bot. Libr., Brown Corr.) relates mainly to this, none of it to the *Instructions* of 1801. That is a pity for Banks seems to have suspected Hawkins of being too persuasive a teacher. Writing on 15 June 1801, Banks set his protégé straight:

> I have too good an opinion of your proficiency in the Science you have undertaken to exercise on board the Investigator to offer you any instructions relative to the mode which is best to pursue it. The Field is large, much greater than any one man can compleatly occupy. My advice to you therefore is that you attend chiefly to those branches of Natural History which you are best acquainted with & in others which may be better brought to perfection

> by Men who enterd more deeply into them, when you return, that you would content yourself with providing Specimens without troubling yourself to make any observations upon them except a carefull notation of the place where they were found with such remarks on their situation in it & on the nature of the Country thereabouts as you may think proper to write down.
> Mr. Hawkins has been so good as to give you ample instruction on the subject of Geology[,] more I fear than you will find it possible to attend to without sacrificing some of the time necessary to perfect your operations on the branches of Science which you yourself are Master of & this I should by no means ever advise you to do[.] Geology [and] Mineralogy must be considerd by you as subsidiary pursuits & you will be requird to do in them no more than is compatible with a full attention to Botany[,] Entemology[,] Ornothology &c.
> The Miner you will find an industrious & attentive young Man and you will I have no doubt find time to direct him in such a manner as will enable him to collect abundance of interesting Specimens, whenever you make any long stay in Port I should advise that after he has examin'd the Rocks & Steep Craggs where the solid Strata may be seen & collected Specimens of all that presents itself on the surface that he be employd with such assistance as can be spard to dig in the bottom of some Valley & orderd carefully to examine all such Stones or other solid bodies as he shall meet with and bring to you all that have a Metalline or other interesting appearance[.] if the water does not obstruct him he may sink a Shaft or Well the timbering of which he knows how to have constructed by the Carpenter & which may be carried about in the Ship & if by means of such a Shaft he can sink through the loose strata to the surface of the solid ones it is upon them he is likely to find fragments of Metals & other valuable bodies whose specific gravity has precipitated them to the bottom—when the Fragments of solid Strata which now cover the surface of the Earth were at some distant period of time in motion. (BL Add MS 32439 ff 41–42)

Banks could at times be muddle-headed, and this statement at least in respect of the miner and digging shafts runs counter to what he had written six months earlier, but the message for Brown was clear. Banks wanted a botanical survey and he was going to have it. He seems to have decided only one naturalist was needed for the expedition—which some (e.g. Brown, 1953) have mistakenly called the Sir Joseph Banks Expedition. Banks would have seen no fault in that. Brown made his name as a botanist by thus serving Banks. That there is material enough for the present study follows from Brown's spare-time activities and from the efforts of a remarkable commander, Matthew Flinders, who deserves to be remembered as scientist as well as navigator.

The Voyager of *Investigator*, 1801–1805

The work of the expedition will be considered in three parts or episodes. The first is the voyage from *Investigator*'s Australian landfall in December 1801 along the southern coast of the continent to Sydney, reached 9 May 1802. Two months later and joined by a tender, H.M.S. *Lady Nelson*, for inshore work, she left Sydney on a run northwards inside the Great Barrier Reef to the Torres Strait. The *Lady Nelson* proving hard to manage in open sea, Flinders ordered her return to Sydney only to find while in the Gulf of Carpentaria his own ship was badly affected by rot. He continued the survey as far as Arnhem Land but then had to abandon exploration and return to Sydney by way of Timor and the southern route. The second leg was destined to be left incomplete. Hoping to get a replacement for *Investigator*, Flinders with most of his party left Sydney for England in August 1803 on board H.M.S. *Porpoise*. The loss of *Porpoise* on Wreck Reef, off the Queensland coast, Flinders' journey in an open boat to bring rescue from Sydney and, the survivors safe on a merchantman bound for China, his own voyage home on a 25-ton colonial vessel (H.M.S. *Cumberland*) which like him was detained by the French on Mauritius for 6 years—these are now popular history. For them, and much else, we have the guidance of the commander's own account (Flinders, 1814). But *Investigator* did not rot away in Sydney harbour. Two years after being abandoned, she managed a non-stop voyage to Liverpool, bringing home Brown and Bauer who had been granted permission to continue their work until Flinders came back or such time as they were ordered to return.

For any study of the expedition the prime source is *A Voyage to Terra Australis*, Flinders' last work. According to Brown (Scott Polar Res. Inst., Cambridge. Lefroy Bequest MS 248/296/2, Brown to Franklin, 25 Aug. 1814) it 'appeared a very few days after his [Flinders's] death'; some have claimed the book was published the day Flinders died, 19 July 1814. At least he was spared knowledge that his widow would be required to make good the financial loss on publication of a book issued with the authority of the Admiralty. It was not intended to be a popular piece. John Franklin (1786–1847), Flinders's cousin and a midshipman on *Investigator*, recognized this in a letter to Brown written from Portsmouth 9 June 1815 after a tour of duty in the West Indies:

> ... the work appears to be most Interesting to men of Science and Navigators—while the casual reader will soon weary of the dry detail of his observations. He has related Facts and circumstances with the utmost accuracy—and spared even that embellishment of colouring which might make them more pleasing to the indifferent reader. His observations are reduced with the greatest nicety and precision; they, together with his charts which certainly are very superior, will I trust gain for him what he most desired, the character of a good Navigator a man of perseverance and Science— ... (Scott Polar Res. Inst., Cambridge. Lefroy Bequest MS 248/296/5)

Franklin was right. Among the dry detail of Flinders's observations are many geological notes, some no more than records of rock-types, others of far wider scientific interest. Franklin could sympathize; he too developed geological interests (Woodward, 1907) and was destined to be an ill-fated explorer.

By way of supplements to Flinders (1814), we have the manuscript diaries of Robert Brown and Peter Good (both in the Botany Library, B.M. (N.H.), as well as manuscript catalogues of rock collections and what remains of the collections themselves in the Department of Mineralogy (B.M. (N.H.)). Not only are these the oldest expedition collections of rocks in the Museum[1] (Campbell Smith, 1969, p. 247), they are the oldest extant collection from the Australian region. Their possible rivals in antiquity, the rocks gathered by Depuch and Bailly during the Baudin expedition, cannot be traced. Enquiries in Paris at the Museum d'Histoire Naturelle, where once they were housed, and at the Centre Océanographique de Bretagne at Brest have proved unavailing. The only souvenirs now are Bailly's manuscript catalogue (Mitchell Libr., Sydney. Copy in Baudin Exped. Paps., B 1265) and a brief account by Leopold von Buch (1814) of his inspection of the rocks in the Paris museum during 1810.

The Voyage to Sydney July 1801–May 1802

Calls at Madeira and the Cape of Good Hope on the way to Australia gave opportunities for Brown and his colleagues to make shore excursions. Their unsuccessful attempt to reach the highest point on Madeira, the volcanic remnant of Pico Ruivo, during which Allen nearly came to grief, was nicely observed by Good (diary, 5–6 Aug. 1801) but, for the most part, the exercises were less strenuous—and more botanical. Although these were places known to European science, Brown found the Cape, in particular, a fascinating place; he was reluctant to leave before satisfying his influential patrons. The Rt. Hon. Charles Greville (1749–1809), collector of minerals, plants and much else, for instance had instructed Brown on the eve of his departure from Spithead to remember at the Cape he was 'not in the Land promised to Kew' (BL Add MS 32439 ff 43–44) adding 'I conclude you all will have recollected many Desiderata, in which case write me word[;] tell Bauer to do so also'. In a tantalizing passage, Greville hoped all 'will be plain sailing' now that 'the awkwardness—which some Late measures might have occasiond' had been 'rubbed off'.

---

[1] According to *Synopsis of the Contents of the British Museum* (8th ed., 1814, p. 54) rocks from King George's Sound (presumably collected by Vancouver) were once on public display at Montagu House. No mention of them can be found in issues of the *Synopsis* after reorganization by C. D. E. Konig (1774–1851) of the museum rock collections about 1817. The samples presumably were lost then.

The Vancouver Island material suffered similarly, and material from Dusky Bay (New Zealand).

Contact with Australia came early in December 1801 when Flinders put in at King George's Sound to prepare for the southern survey. There and for some way eastwards they were in waters examined by others. George Vancouver (1757–1798) had discovered and named the sound in 1791. His account (Vancouver, 1798, **1**, pp 49–50) is full of interest; 'two or three sorts of granite', slate, quartz, sandstone, 'marle' and 'coral' were found. He or his naturalist, Archibald Menzies (1754–1842), even tested some of them with acid and the blowpipe. But it was the 'coral' that most attracted Vancouver, as it did the party from *Investigator* and the French scientists with Baudin who visited the place in February 1803. According to Vancouver, the branching 'coral' exposed in white calcareous sand and sandstone on the tops of prominences like Bald Head was clear evidence that the land had only recently emerged from the sea. It was taken up enthusiastically by the French (Péron, 1804) and provided an example for Cuvier (1825, **1**, p. 17) in support of his model of catastrophic operations in the geological past. Darwin (1844, pp 144–148) also quoted Péron with approval.

Flinders (1814, **1**, p. 63) accepted Vancouver's interpretation that the branching material was coral, adding merely his own description. Good (diary, 20 Dec.) likewise thought it coral. Brown (diary, 20 Dec.), however, took a more critical interest. He talks of 'roots of trees petrified' and comments on the thickness and branching of the calcareous bodies. 'Can these branches be coral[?]' he asked, adding the observation that 'their being so frequently prostrate and all traces of their original structure being obliter[ated] are arguments against this'. But, Brown persisted, if wood how was it petrified, at the bottom of the sea? After closer examination failed to discover signs of woody structure, Brown left the matter; he was still dubious but prepared to call the material coral. If now we recognize that corals do not inhabit such southern waters and that the 'coral' at King George's Sound is of concretionary origin, there is nothing with which to reproach Brown. His careful intelligence gave a hopeful start to the expedition's geological work. Nearly a year later, when at Sweer's Island in the Gulf of Carpentaria, he had no trouble distinguishing concretionary pseudo-coralline material from real coral (see p. 19).

From King George's Sound, *Investigator* moved on to the Archipelago of the Recherche, anchoring in Lucky Bay, east of Esperance Bay. Flinders simply noted the place on his working charts as Bay I and this notation is followed by the diarists. Burbidge (1956) provides a key correlating the survey notation with names bestowed later. At Lucky Bay, Flinders was on new ground though the archipelago had been visited by a French expedition led by J.-A. R. Bruny D'Entrecasteaux (1739–1793) in December 1792. The naturalist J.-J. H. de Labillardière (1755–1834) noted the occurrence on the islands of the archipelago of white calcareous sand and sandstone lying over granitic rocks (Labillardière, 1800, **1**, pp 449–450). It repeated the pattern seen at King George's Sound and, as Flinders and Brown were to find as they went eastwards, characterized much of the southern coast. Flinders (1814, **1**, p. 89) thought it 'may perhaps afford some light to the geologist' and later (**1**, pp 96–97) began to wonder what sort of country ('flat, sandy plains or water'?) lay behind the remarkable cliffs of horizontal calcareous strata.

Not until *Investigator* reached Bay IX (Memory Cove, South Australia) is there much sign of rocks other than granitic types and the coastal limestone. Brown's first sample from Memory Cove he described as 'Sienites: vulgans est magnam partem terrae prope Memory Cove efformat' in his catalogue. There follow specimens of vein rocks in the so-called syenite but finally (No. 5) comes something familiar: 'Particuli sphaeroidalis ferruginose in lapide arenaceo-calcareo. frequentes praecipice in collo supra Memory Cove.' For about six weeks at this stage, Brown made all his catalogue notes in Latin. Flinders (1814, **1**, p. 140) added his remarks on the rocks at Memory Cove and it is interesting to notice how commonly his rock-names differ from those used by Brown. There are few signs of collusion. Indeed, Flinders employed a wider range of terms than Brown and, as he wrote his book more than ten years after making the observations and without the benefit of specimens one assumes his diagnoses, like Brown's, were made on the ground. Flinders clearly had a good working knowledge of lithology. Without the advantages of instruction by Walker and Hawkins, Flinders showed a surer touch in such matters than Brown. So often Brown's catalogue entries are no more than vague records of localities; that was all Banks (letter to Brown, 15 June 1801) expected.

The stop at Inlet XII (head of Spencer Gulf, South Australia) brought an opportunity to

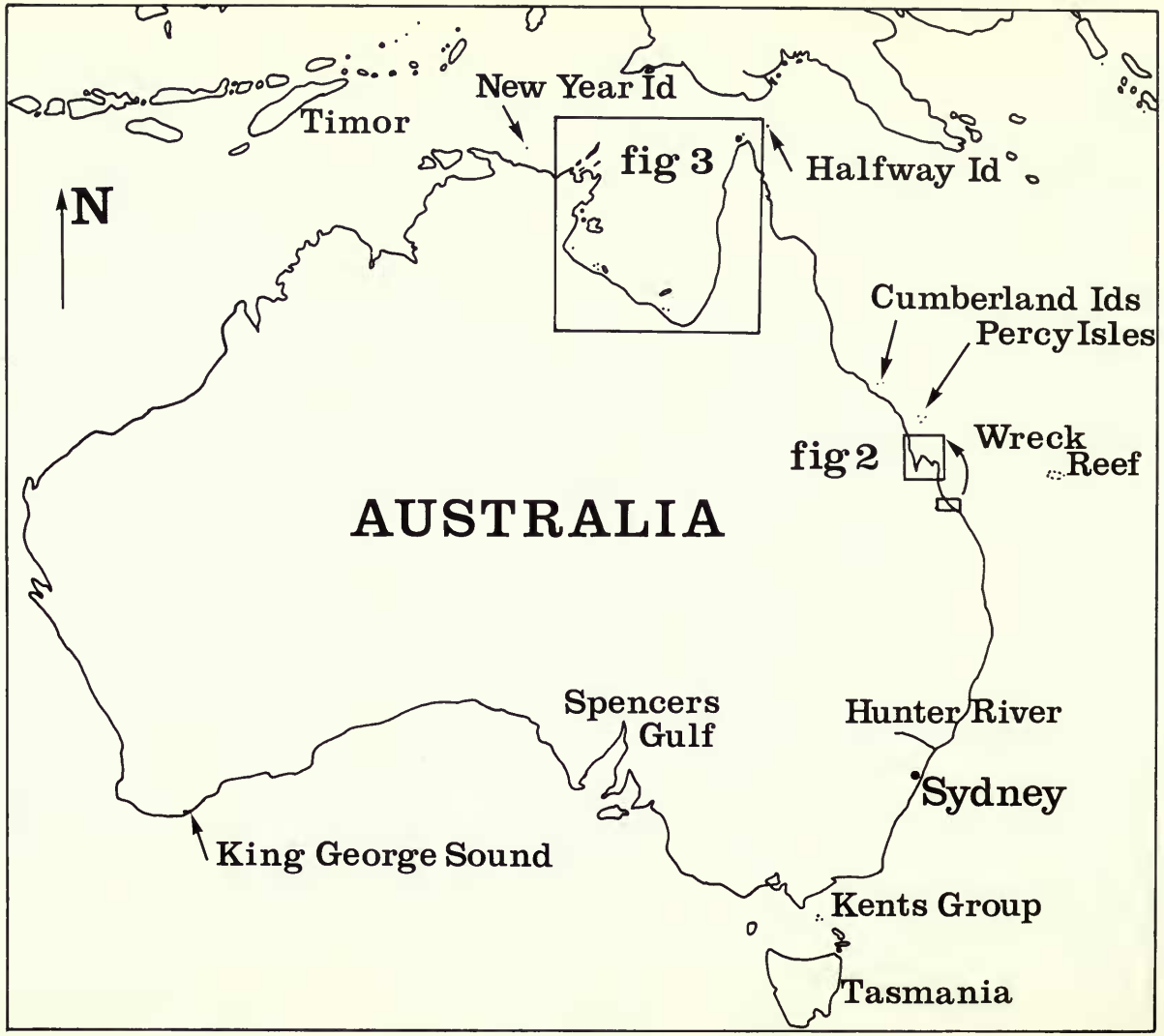

Fig. 1 The collecting localities of the *Investigator* 1801–3, and some places visited by Robert Brown in 1804.

explore away from the sea. By now the great cliffs of coastal limestone were far behind and the country more accessible. So, while Flinders continued his boat-work, Brown took his party inland. As usual, the main concern was botany but the geological situation should have provided interest; it was different from that hitherto. On this excursion the party crossed a terrain composed chiefly of slates to gain the summit of what Flinders was to call Mt Brown, the highest point reached during the survey voyages. Only two specimens of rocks, one from the mountain, were taken and that despite the fact Brown saw (diary, 10 March) veins 'of a metallic substance resembling Molybdæna or black lead'. Banks had given instructions about such things; Allen should have been directed to gather a sample, at least.

The micaceous schists of Kangaroo Island also failed to divert Brown. Two specimens sufficed for the whole island. From a fairly ambitious start (Brown listed 22 items in his collection from King George's Sound), rock-collecting had become practically an otiose activity. The three anchorages between Kangaroo Island and Sydney yielded no rocks at all. Flinders, however, continued to add geological notes to his record, perhaps also enlarging his own collection. That he did collect rocks follows from statements regarding the wreck of the *Porpoise*: 'my little collection in mineralogy and conchology was much defaced, and one half lost' (Flinders, 1814, **2**, p. 311). Later, 'a cask containing what had been saved of my specimens of mineralogy and conchology was taken on board' the *Cumberland* (Flinders, 1814, **2**, p. 329), only to be confiscated at Mauritius. The collection was never returned to him (Flinders, 1814, **2**, p. 484). We assume the references to *his* collection serve to distinguish it from that made by Brown and his assistants.

Of Brown's collection from this part of the voyage nothing remains except his manuscript catalogue (Mineralogy Library, BM (NH)) listing some 65 or 70 specimens from 11 of the 18 anchorages made. It seems probable these were lost with the *Porpoise*. With them presumably were seven samples of coal, porphyry, granite and 'argillaceous rock' from the bed of the Hawkesbury River about its confluence with the Grose River in New South Wales and another three specimens from the 'rivulet behind government house' at Parramatta, by-products of botanical excursions from Sydney while *Investigator* was being prepared for the second stage of its voyage.

Depuch and Bailly, the mineralogists attached to the Baudin expedition, did rather better during their visit to Sydney in the following year (Péron and Freycinet, 1816); it would have been surprising if they had not. Beside collecting specimens, Depuch and Bailly began the more challenging business of discovering geological relations. They saw, for instance, that a succession of shales with fossil 'ferns' lay over sandstones at Parramatta and suggested a bore-hole there would intersect at depth the coal known to lie below sandstones in coastal exposures north and south of Sydney. Nothing could have demonstrated more clearly the limits to Banksian vision. Trained mineralogists attached to a marine surveying expedition could make discoveries of importance both practical and scientific, just as Flinders and others had argued. A 'practical miner' was no answer.

Writing to Banks from Sydney 30 May 1802 (*HR NSW*, **4**, pp 776–779), Brown reported how loyally he had followed instructions: 'In mineralogy, I have hitherto collected what merely presented itself'. To his friend, Banks's librarian Jonas Dryander (1748–1810) went the message 'In mineralogy we have extremely little variety' (*HR NSW*, **4**, pp 773–775). The record of Flinders is enough to prove otherwise. At King George's Sound, Brown had tried to cover the several branches of natural history—and performed creditably. The later stops, of more limited duration, were largely given over to satisfying the interests of botany.

The Voyage to Arnhem Land and Return to Sydney July 1802–June 1803

In 1799 Flinders had gone as far north from Sydney as Moreton Bay and though he missed the entrance to the river on which the present city of Brisbane stands he did chart the coast and recognize the extinct volcanic character of the Glasshouse Mountains (Flinders, 1814, **1**, p. cxcvi). Now he proposed to examine the coast northwards from Moreton Bay, a coast fringed by the coral reef system that made it dangerous to mariners. The reef had nearly proved Captain Cook's undoing in 1770; in little more than a year Flinders was to be wrecked on it.

Work on the second leg of the expedition followed the pattern established during the voyage to Sydney. Occasionally, Brown or others of his party would accompany Flinders in the boat but more often they collected as a distinct group or as individuals. Flinders, Brown and Good continued to keep journals; for this part of the voyage they have an added importance. As before, they serve to illuminate obscurities in Brown's catalogue of rocks (or, as he called them this time, *fossils*—a word which in the general sense of things dug up was already becoming old-fashioned) but the illumination is more necessary here because part of the collection still exists. There are, in fact, two lists or catalogues of rocks relating to this part of the voyage: Brown's manuscript covering the period July 1802–April 1803 and another entitled *Minerals collected on the East Coast of New South Wales August 5–10* 1802. Both are now in the Mineralogy Library, BM (NH). Edwards (1976, p. 401) refers to this second document as 'probably in the hand of the miner, Milnes'. Miss Edwards has confused Milnes with Allen. We believe the hand is not that of John Allen and incline to a view (with which Miss Edwards disagrees) that the author was Peter Good. No specimens to match that list have been found.

Roughly half the samples noted by Brown remain in the collections of the Department of Mineralogy, BM (NH). As all derive from the second leg of the *Investigator* expedition and collectively form a unique source in the history of Australian geology, we here supply a transcript of Brown's catalogue as a guide to the geological effort at this stage. Annotations relating actual specimens to entries in the catalogue, as well as notes on the petrography of the samples, their likely collecting-localities and stratigraphical positions, are interspersed. However, before presenting this document it is necessary to offer some explanatory remarks, not least because striking differences will be found between the present statement and that given recently by one of us (DTM) in Edwards (1976, pp 399–401). Close examination of the manuscript catalogue, the original paper labels, museum register and the specimens, has brought to light considerable errors in registration, most of them due to a misreading of labels and the failure of one museum department to communicate with another, some to careless observation of the specimens. The experience provides an object lesson for curators of historic collections. The keys to the problem lie in the manner of treatment, taking treatment as a word subsuming neglect.

Leaving aside the circumstances whereby the collection reached England, matters to which we attend later in this study, it is noted that the rocks went to the British Museum at Montagu House in 1811, a gift from the Admiralty. They were not registered until 1894–5 (indeed, registration of rocks and minerals did not begin until 1837). During the intervening years, this collection like the rest of the Museum's rock collections suffered disturbance, damage and loss. Campbell Smith (1969, p. 258) refers to damage, and worse, at Montagu House in the 1820s. There was more disturbance when Montagu House was replaced by Smirke's museum building and then in 1880 came the final move from Bloomsbury to South Kensington. Brown himself raided the collection, probably near the beginning of 1826, giving to W. H. Fitton (1780–1861) pieces for his study of rocks from northern Australia (King, 1826, **2**, pp 566–629). In the preface to his book, King mentions that Fitton received the samples after other parts of the natural history contributions had been printed. The samples used by Fitton eventually passed to the museum of the Geological Society of London. In 1911 they returned to the British Museum; we say returned advisedly, for they were broken from specimens already there.

With such casual care it is wonder enough that any part of the collection remains but the business of registration was no less strange. The rocks must have come to the museum with only the paper labels. Brown did not hand over his manuscript catalogue. It passed, presumably after his death, into the possession of the Department of Botany and remained there until 1906 when it came to the Department of Mineralogy. The cataloguer in the 1890's, ignorant of this document, meanwhile had registered the rocks on the basis of what he could make of the labels. He was unaware too of the notation used by Flinders at the time of the survey. Thus an inscription like *Carpentaria Island s*, the first word indicating the section of the voyage, became in the register Carpentaria Island—a splendid geographical fiction that would unite all the scattered islands visited by Flinders in the Gulf of Carpentaria. We believe the rocks are now restored to order, 171 years after they were donated by the Admiralty.

Brown's catalogue fills 40 pages of a leather-covered notebook (11 × 18 cm) containing 30

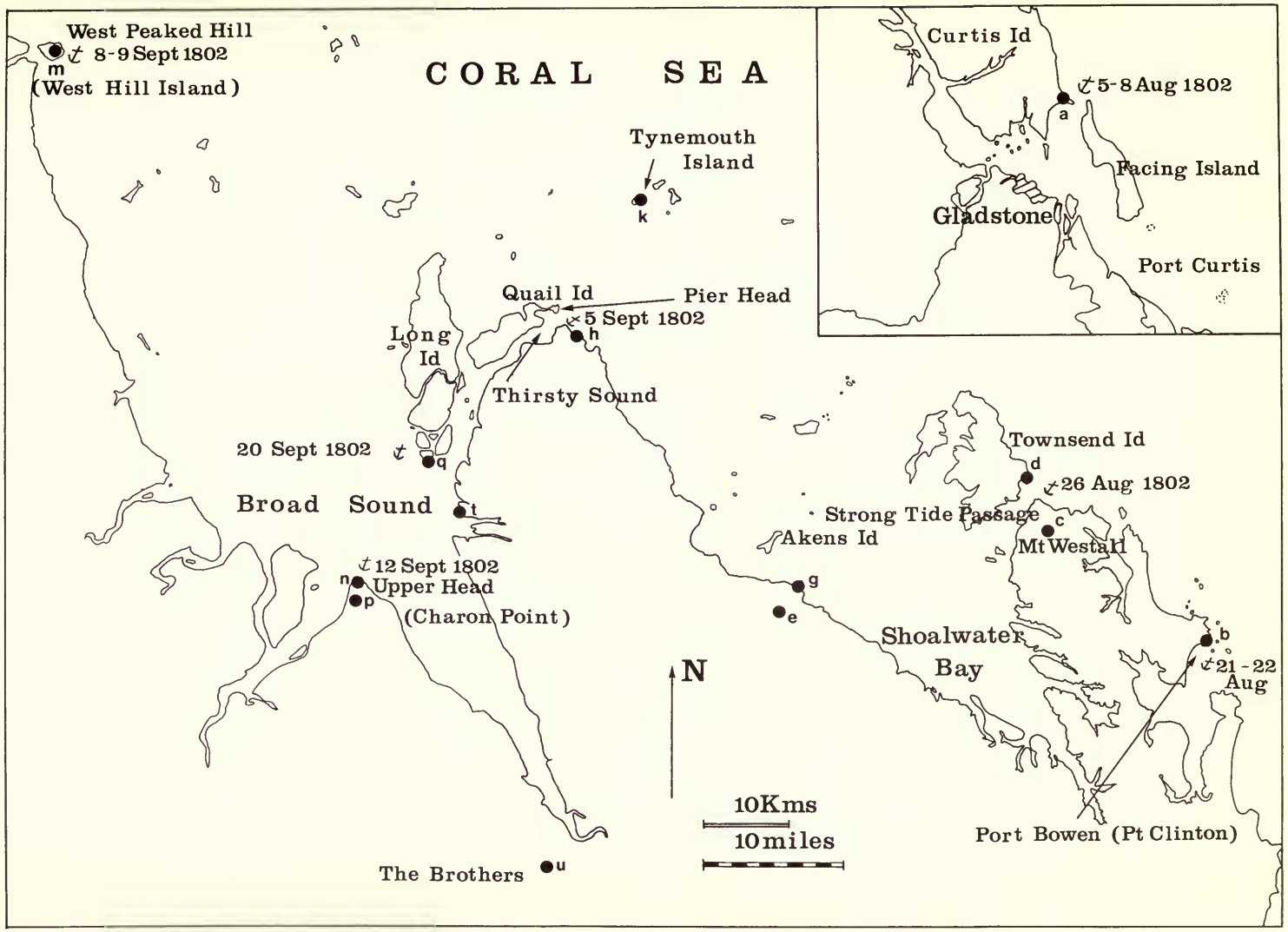

Fig. 2 Localities of surviving rock specimens collected by members of the *Investigator* scientific party in the Shoalwater Bay–Broad Sound area of Queensland. August to September 1802.

sewn leaves; it has been transferred recently (1977) from the files of the Rock Collection to the Mineralogy Library, BM (NH). In the following text, Brown's spellings and erratic punctuation are preserved though, for the sake of economy, his spacings of lines are not. The original text is rendered in italics; our insertions stand within brackets. From time to time, Brown added minor notes to the document. They are indicated in our edition; there should be no difficulty distinguishing those added after Flinders converted his geographical symbols into normal place names from those connected with Fitton's interest.

An annotated transcript of Robert Brown's catalogue of rocks collected August 1802–April 1803

Catalogue of Fossils collected on the East Coast of New Holland [blank] space [blank] *1802, also the Gulf of Carpentaria Prince of Wales' Islands*

Sandy Cape Herveys Bay Lat: [blank] *Long:* [blank]
July 31–1802
[space left blank]

Port No I [Port Curtis] *Lat :* [blank] *Long :* [blank]
Aug^{t} 5–8—1802

No I Red ochre, used by the Natives for painting their bodies &c taken out of one of their Canoes
[No specimen]

No II Yellow Ochre—us'd by the Natives for painting their bodies, &c taken from one of their Canoes
[No specimen]

No III forming a small rounded hill about a mile from the beach opposite to the anchorage
[BM 75774 original label: *East Coast Port I No 3 16)* Refs: Flinders, **2**, 15 ff; Brown and Good diaries.
A fine-grained grey quartzite (a recrystallized quartz greywacke), distinctly jointed and superficially iron-stained, the sample appears to have been collected just north of the present Southend, at the SE extremity of Curtis Island (Fig. 2, position marked a). The rock may be assigned to the Palaeozoic Shoalwater Formation (Sheet SF 56-13, Rockhampton, Queensland, 1 : 250 000 geological series). A small specimen registered as BM 75786 (Northumberland Islands, No 2) is, in fact, a fragment broken from BM 75774; they are now together at this latter position. During the stay at Port Curtis, Brown landed only on what was then thought to be the mainland (Curtis Island); Good, and probably Allen, visited Facing Island twice. Flinders ventured further into the port and also made geological observations (Flinders, **2**, 20).]

No IV forming rocks on the shore about a mile & half from the anchorage Schistus
[No specimen]

No V Pumice Stone. found thrown on the beach, in considerable abundance that side of Facing Island next the anchorage
[No specimen]

No VI Small flat rocks in facing island—in one place only :
[No specimen]

No VII Breccia forming small rocks covered at high water in Facing Island—
[No specimen]

No VIII Calcareous sandstone about $\frac{1}{4}$ mile from the beach end of Facing Island; small rocks scatterd on the surface.
[No specimen]

Keppel Bay Aug^{t} 9th–16th—1802

No I Petrosilex, forming rocks on the shore opposite to the anchorage
[No specimen]

No II Petrosilex (?) with the particles of Quartz (?) on the surface, on the hill about half a mile from the beach opposite to the anchorage
[No specimen]

No III Quartz, on the surface, sides of the hill about half a mile from the beach opposite to the anchorage
[BM 75775 original label: *Keppel Bay No 3 22)* Refs: Flinders, **2**, 22 ff; Brown and Good diaries
A ferruginous chert with a vein of milky quartz, the sample was probably collected near Dinky Point of present maps. Assigned to the Palaeozoic Wandilla Formation (Sheet SF 56-13).]
No IV Rocks coverd at high water on the beach opposite to the anchorage consequently inferior to the Petrosilex (No 1)
[The sample with label (not original) *Keppel Bay No IV (No 23)* and registered as BM 75766—Quartz, Keppel Bay, E. Coast, Australia—is, in fact, a fragment broken from BM 75819 (q.v.—p. 27). *Keppel Bay No IV* cannot be found.]

Port II [Port Clinton, Port Bowen of Flinders] *Aug^{t} 21–22—1802*
No I Rock forming the two Mountains we ascended on 21 & 22^{d} — —
[BM 75816 original label: *Port 2 No 1 65)* Refs: Flinders, **2**, 36 ff; Brown and Good diaries. Registered as a quartz felsite, the material consists of phenocrysts of resorbed quartz and two feldspar phases (both much decomposed) in a matrix of devitrified welded glass shards; the rock is a rhyodacitic ignimbrite from the Peninsula Range Volcanics (Permian-Cretaceous). The locality (Fig. 2, letter b) is just north of Perforated Point (Sheet SF 56-9, Port Clinton, Queensland, 1 : 250 000 series).]
No II forming the rock at the second beach of the [blank] *side of the Port, where we landed the 21st*
[No specimen]
No III forming the rock at the first small beach where the ship water'd
[No specimen; for a sketch of this place see Flinders, Atlas pl XV (Sic—but in fact XVIII), sheet 2, profile No 9]
No IV In a vein about 14 feet wide forming the bottom of the Gully immediately behind the beach. Where the ship water'd. contained in No III
[No specimen]
No V Variety of No 1 or 2,
[No specimen]

Harveys Islands, between Island Head & Cape Townshend consist of the same rock as No I II, III, of Port II, in one place columnar, columns inclin'd, not jointed, seen at a distance [cf. Brown diary (25 Aug.)]

Shoal Bay Passage [Strong Tide Passage of Flinders and modern maps]
Aug^{t} 26—1802
No I forming the rock at the bottom of the high mountain which we ascended
[BM 75790 original label: *Shoal Water Bay Passage Aug 26, 1802 No 1 77)* Refs: Flinders, **2**, 40 ff; Brown and Good diaries.
Registered as a quartz porphyry, the rock is a rhyolitic ignimbrite far more devitrified than BM 75816. Its similarity to rocks observed at Port II (Port Clinton) was noted by Brown in his diary; all are now placed in the Peninsula Range Volcanics (Sheet SF 56-9). The collecting locality is at the northern foot of Mt Westall (Fig. 2, letter c), *the highest* [hill] *we had been on in New Holland except one* according to Good.]
No II forming the summit of the high mountain which we ascended
[No specimen]

Cape Townshend Island Aug^{t} 28th 1802
No I Micaceous schistus, with thin veins of Quartz, forming the base of the Island, as far as seen
[No specimen]
No II Differing from (No I) in being destitute of quartz [i.e. vein quartz]
[BM 75777 original label: *Cape Townshend Islands No 2 6)* Refs: Flinders, **2**, 44; Brown diary.

This grey fine-grained quartz-sericite schist, a low-grade metamorphic representative of the Shoalwater Formation, appears to have been collected at the SE corner of the island (Sheet 56-9)—Fig. 2, letter d.
The rock composing this island is very different from that of the opposite main (Brown diary 28 Aug.).]

Shoal Bay South Shore Aug^t 30—1802

No I In the bed of the Rivulet proceeding from the Mountains; about 2 miles from the beach
[BM 75789 original label: *Shoal Water Bay South Shore in the bed of the rivulet about 2 miles from the beach 82)* Refs: Brown and Good diaries.
Registered as a quartz porphyry, the rock is more like a quartz-bearing microdiorite porphyritic in plagioclase and containing grains of clinopyroxene infested with green amphibole. Intrusive bodies mapped as granodiorite in the Normanby Range (Sheet SF 56-9) seem a likely source. According to Brown's diary the party landed (near the present Sabina Point) and moved inland to the SW some 3 miles before reaching *a small rivulet then nearly dry in many places but at certain seasons must be {from the breadth of its bed (36 or 40 feet) the quantity & size of the water worn stones in it & the height of its alluvial banks} very considerable ... In the bed of the Rivulet we found fragments of Granite, Porphyry & Whinstone.* The locality may be identified as in Rocky Creek, about 3 miles SW of Sabina Point (Fig. 2, letter e).]

No II with the former;
[No specimen]

No III Whin Stone, water worn fragments, bed of the Rivulet, with the former—
[BM 75788 original label: *Shoal W*[ater] *Bay No 3 78).* The sample is part of a rounded cobble of dark, fine-grained quartz greywacke containing some volcanic detritus. It was probably derived from the Shoalwater Formation (Fig. 2, letter e).]

No IV Variety of No III; same situation
[No specimen]

No V forming low rocks, coverd at high water, on the shore where we landed
[BM 75787 original label: *Shoal W. Bay No 5 79)* Refs: Brown and Good diaries.
The rock consists of abundant subhedral feldspar (mainly plagioclase) and less common resorbed quartz grains in a granular interstitial matrix; it is a dacitic crystal tuff. On Sheet SF 56-9, the area about Sabina Point (Fig. 2, letter g) has the shading for superficial Tertiary-Quaternary deposits but Brown's comments imply the rock collected was *in situ.* Perhaps volcanic materials like those known to form the Double Mountain Volcanics south of Sabina Point extend to the coast in places.]

No VI In the Bank of the Rivulet with Nos I–IV
[No specimen]

Shoal Bay Sep^r 3^d 1802

No I Top of the Peaked hill, the greater part of the hill consists of this stone, & its variety No II
[and added in pencil] *German Basalt* [Flinders, **2**, 48–49, makes it clear this Peaked hill is his Pine Mount. Brown (diary) thought the *Hill consists of a fine grain'd porphyry graduating I believe into whin stone;* Flinders (**2**, 50) termed it the *greenstone* of the German mineralogists. The specimens have not been found.]

No III Petrosilex sporadic in micaceous schistus of the same kind to that composing Cape Townshend Island, in the dry bed of a rivulet in the plain between our landing place & the bottom of the peaked hill
[No specimen]

Thirsty Sound, entrance East side—Sep^r 5^th 1802

No I Low point near the base of the round hill—opposite to the anchorage—
[BM 75797 original label: *Thirsty Sound entrance, east side No 1* Refs: Flinders, **2**, 53 ff; Brown and Good diaries.
Under the microscope this rock, registered as a pyroxene granodiorite, is seen to consist of

albite, chlorite, epidote and calcite. There is a slight schistosity and traces of a relict basaltic (?) texture suggest the material is a metamorphosed basic igneous product. The source of the rock is uncertain. Flinders and the two diarists agree that on 5 Sep. all the 'scientists' except Bauer worked on the mainland. Perhaps the sample (Fig. 2, letter h) is from a flow or intrusive body in the Devonian terrain SE of Arthur Point (Sheet SF 55-12, St Lawrence, Queensland, 1:250 000 series).]

No II superincumbent on No I

[BM 75796 original label: *Thirsty Sound No 2 98)*

Registered as a weathered sedimentary rock, this whitish material (where not iron-stained) is, in fact, a fine-grained sericite-quartz schist. The quartz occurs as grains of various shapes and sizes, some indeed is of late-growth related to veining but other grains seem to be blastophenocrysts. That being so, the original rock was probably an acid volcanic product like rhyolite or rhyolitic tuff. Such materials are reported in the Devonian succession SE of Arthur Point (Fig. 2, letter h).

No III Top of the round hill opposite to the anchorage—

[No specimen]

Pier head No IV—Porphyry, graduating in some places into trap (?) composing the round hill, call'd Pierhead on this hill the magnet was considerably affected,

[No specimen]

B Island in the offing about 3 leagues from our anchorage in the entrance of Thirsty Sound—

No V, The common rock on the shore of the Island C. Flinders

[BM 75792 original label: *Island near the entrance of Thirsty Sound No 5 91)* Ref: Flinders, **2**, 55–56.

A diorite with much-altered subhedral plagioclase, uralitized hornblende, chloritized biotite and interstitial quartz, the sample (collected by Flinders) is veined by quartz and epidote. On 6 Sep. Flinders and Westall visited what were called the 6th, 7th and 8th Northumberland Islands. Island B of Brown is the 7th island (now Tynemouth Island)—Sheet SF 56-19 where it is mapped as gabbro or diorite (Fig. 2, letter k).]

Broad Sound Sep^r 9th—1802

West Peakd Hill—[West Hill Island of Sheet SF 55-8, Mackay, Queensland, 1:250 000 series]

No I & II forming the hill & the rocks along the shore II only on the shore, the rock divided into cubes or trapeziums of different sizes, by thinish laminae of brown stone in other respects nearly the same as that composing the cube or body of the rock,

[BM 75780 original label: *Broad Sound, West peaked hill No 1 10)* Refs: Flinders, **2**, 60; Brown diary.

Termed a quartz-hornblende microgranite in the BM (NH) register, this greenish-grey rock consists principally of microscopic laths of saussuritized plagioclase mantled by clear, granular quartz; green amphibole and chlorite are also present. The rock appears to be an altered andesite or microdiorite. On the Mackay geological sheet the island (Fig. 2, letter m) is shown as composed of Tertiary volcanic material.

BM 75782 original label: *Broad Sound, West Peaked Hill No 2 11)*

The laminae of brown stone mentioned by Brown are ferruginous products, due to weathering, along joint planes. In his diary, Brown termed the rock *a species of trap?* and gave details of the variety of jointing. Flinders (**2**, 60) considered the rock *was not unlike that of Pier Head; but it had a more basaltic appearance* (Fig. 2 letter m).]

Broad Sound Low Island—[?Avoid Island] *Sep^r 10 1802*

No I Rock divided in the same manner as No II of last anchorage viz^t west Peaked hill The specimen shews the common size of the division with its walls

[No specimen]

Broad sound— Upper head— Sep^r—12 1802

No I forming the hill calld in the chart Upper head the low rocks on the shore abreast of the anchorage. where the tents were pitchd Sep^r 26—

[BM 75779 original label: *Broad Sound, Upper Head No 1 9)* Refs: Flinders, **2**, 71; Brown diary.

A microcline-rich leucogranite with both muscovite and biotite, the rock has a remarkably fresh appearance. Flinders's Upper Head appears to be Charon Point (Fig. 2, letter n) on Sheet SF 55-12, St Lawrence, where the vicinity is shown as occupied by the Lower Permian Carmila Beds. Yet Brown's note suggests granite is *in situ* there and Flinders stated that Upper Head consists of granite.]

No 2 forming small rocks by the side of a flat frequently over flow'd by the tide, near upper head, towards the nearest fresh water—

[No specimen]

No III Sep^r 15—1802 Schistus forming strata dipping more or less, by the side of a rivulet near the bottom of the first chain of hills about 3 miles from Upper head—

[No specimen remains. Brown (diary, 18 Sep.) reported that on 15 September Good and Allen walked to the nearest range of hills and the *stone which according to M^r Allen composes the hill they ascended is different from any we had hitherto seen.* Good (diary, 15 Sep.) merely observed: *The Stones of this part are various Granite Porphyry & Schistus.*]

No IV Sep^r 26—1802 Dry Bed of the rivulet near the side of the thicket about a mile from Upper head towards the shore of the smaller inlet

[No specimen]

No V Sep^r 26—1802 With No IV, both forming a considerable proportion of the stones in the bed of the rivulet

[BM 75781 original label: *Broad Sound Upper head No 5 12)* Refs: Brown and Good diaries (the appropriate entry for Brown is dated 27 Sep.—at this period his chronology is one day ahead of Good's and Flinders').

Close examination of this light-coloured rock, apparently porphyritic in two feldspars and quartz, shows it to contain volcanic rock fragments which indicate a pyroclastic origin. The felsic matrix has some layered character but is affected by a feeble metamorphism that has generated sericite and epidote. A likely source is the Lower Permian Carmila Beds which are said to be rich in acid volcanic material (Sheet SF 55-12). The collecting-locality (Fig. 2, letter p) for this rhyodacite tuff was in a tributary of the Styx River, a few miles S of Charon Point.]

Broad Sound—Inner entrance of Thirsty Sound Sep^r [blank] *1802*

No VI Sep^r [20] *Forming the greater part of the very small Island* [blank] *side of the inner entrance of thirsty Sound*

[BM 75794 original label: *Thirsty Sound inner entrance No 6 93)* Refs: Flinders, **2**, 67; Brown diary (21 Sep.); Good diary (20 Sep.). The very small island is identified as one of the Mangrove Islands (Sheet SF 55-12) at the southern end of the group known as Long Island. The sample, cream to pink in colour, is deeply weathered. An array of irregular fractures is outlined by accumulations of secondary iron-oxides. Relict textures suggest the rock was of acid volcanic origin (probably pyroclastic) though all feldspar has been replaced by clay minerals. Sheet ST 55-12 gives no clue about this sample for the area about Mangrove Islands (Fig. 2, letter q) is mapped as Quaternary alluvium. This and the next two specimens, if true to label, indicate older strata crop out in the area.]

No VII Sep^r [20] With the former {No VI} forming small rocks on the shore

[BM 75795 original label: *Thirsty Sound inner entrance No 7 94)*

A ferruginous material registered as an ironstone nodule, it seems more like a rounded cobble of a pisolite conglomerate with limonitic cement. Lateritic gravels are known in the vicinity (Sheet SF 55-12)—Fig. 2, letter g.]

No VIII Sep^r [20] *picked up on the inner shore of the same Island—*

[BM 75793 original label: *Inner entrance of Thirsty Sound No 8 92)*

A dark-grey banded siliceous mudstone, its rodded character suggests the rock belongs to some deformed terrain such as may be presented by the older Palaeozoic units recognized in the Thirsty Sound area (Sheet SF 55-12), e.g. on the mainland opposite. (Fig. 2, letter q).]

No IX Sep^r [21] *on a small peninsula of the main intersected by mangroves. forming rocks on the shore in some places low in other places upwards of 20 or 30 feet high. in various degrees of induration. the higher generally softer & almost wholly a deep red*
[No specimen]

No X Forming strata a few feet in thickness near the top of a bank in the peninsula with No IX
[BM 75791 original label: *Thirsty Sound inner entrance No 10 90)* Refs: Flinders, **2**, 67 ff; Brown diary (22 Sept.); Good diary (21 Sept.)
Brown thought this place *remarkable for its blood red cliffs* an island; Good calls it *the main.* According to Brown, the cliffs *we found to be compos'd of the same stone as the island on which we landed yesterday but more strongly & uniformly impregnated with iron.*
The present sample, a light-brown banded mudstone, is neither particularly like those from the last locality nor especially ferruginous; it may resemble the Lower Permian sediments mapped on Quail Island (Sheet SF 55-12). The collecting-locality was on or near Island Bluff (Fig. 2, letter t).]

Broad Sound near its head

No XI forming the hill from which C. Flinders took his bearings. The stone slightly magnetic; C. Flinders suppos'd his needle was considerably affected on this hill [and added in pencil] *Greenstone D^r Fitton*
[BM 75778 original label: *Broad Sound near its head No XI 8)* Refs: Flinders, **2**, 66; Brown diary (15 Sep.).
The sample is a hypersthene gabbro with remarkably fresh calcic plagioclase (bytownite-labradorite) and mantles of pale brown hornblende on pyroxene grains. From Flinders' map the locality is found to be The Brothers, mapped on Sheet SF 55-9 as composed of gabbro/diorite. Both Flinders and Brown called the rock a granite (Fig. 2, letter u).]

Northumberland Islands

No I Small Pine Island Sep^r 30 [Percy Isles, fig. 1.]
[BM 75785 original label: *Northumberland Isles No 1 71)* Refs: Flinders, **2**, 78ff; Brown diary (1 Oct. (= 30 Sep.)); Good diary (30 Sep.).
Although registered as a hematite-stained limestone, the rock is a volcanic agglomerate with a distinct reddish-brown band veined by calcite. It was collected on one of the two rocky Pine Islets, adjacent to No 2 Percy Island on Flinders' map; Sheet SF 56-5, Percy Isles, Queensland, 1 : 250 000 series, is not available. Passing references to the Percy Isles (*J. geol. Soc. Austr.*, **7**, 1960, pp 144 & 222) indicate a volcanic character and Palaeozoic (?Devonian) age. Flinders (**2**, 80) made geological observations on these islands; his comment that the most abundant rock was *a connected mass of different substances, held together by a hard, dark-coloured cement* may well refer to material like the present sample.]

No II found loose forming part of the rocks at the extremity of the small pine Island towards the anchorage
[The specimen registered as BM 75786 and accompanied by original label: *Northumberland Isles No 2 72)* is a small piece of quartzite which fits exactly on the side of BM 75774 from Port Curtis. The real Northumberland Isles No 2 cannot be found.]

No III forming the Projecting rock top of the ridge; abreast of the first anchorage about a mile from the beach at which we water'd
[No specimen]

No IV forming considerable rocks in & near the gully which contain'd water & at the bottom of which the ship water'd—Oct^r 1—1802
[BM 75783 original label: *Cumberland Island Oct 1 1802 No 4 68)*
Catalogue entry and original label do not agree. The Cumberland Islands were not

sighted until 15 Oct. and only three samples taken there are noted (see below). Brown corrected the error in his diary on 1 October, a day he and Good worked on board ship. The date on the label presumably relates to the day before, when Brown was on Flinders' Percy Island No 2. Our belief that the sample came from this island (in fact, from its western side) is supported by the agglomeratic character of BM 75783 (cf. BM 75785). Registered as an ignimbrite, BM 75783 is a greenish agglomerate rich in porphyritic dacite (?) fragments.]

No V forming rocks near No IV

[No specimen]

Cumberland Islands Oct^r 16—1802

Island I

No I forming the rocks on the shore near the landing place (old chart) the whin stone in greater proportion

[No specimen]

No II forming rocks near the former towards steep cliffy extremity of the Island—

[No specimen]

No III Top of the island loose fragments on the surface but the rocks consisting of the same stone

[BM 75784 original label: *Cumberland Islands No 3 70)* Fig. 1. Refs: Flinders, **2**, 94; Brown diary (16 Oct.).

A greenish-grey rock, registered as a chlorite-biotite dacite, it is more like an altered biotite-bearing quartz microdiorite, porphyritic in plagioclase. *The Island on that side we landed is compos'd of Granite &* [space] *primitive whin stone of this last the steep cliffs at the extremity of the island probably consist* (Brown diary).

As only one of the Cumberland Islands seems to have been visited, Brown's Island I must be that denoted l_2 on Flinders' working chart and later named Calder Island. This place is mapped as consisting of leucocratic alkali granite on Sheet SF 55-4, Proserpine, Queensland, 1 : 250 000 series.]

Torres' Strait Low Island d Lat [blank] *Long :* [blank]
Oct^r 30—1802

Composed of calcareous grit with small fragments of coral & shells rarely entire shells spec marked A

[BM 75798 original label: *Torres Strait Low Island 7)* Refs: Flinders, **2**, 114 ff; Brown diary (30 Oct.)

Low Island, about half a mile in circumference, at the surface compos'd of coral grit conglutinated . . . of a light ash colour sometimes containing shells (Brown diary). The sample is, indeed, a lithified calcareous grit, though it lacks the mark A. Brown's catalogue entry resolves a difficulty (Burbidge, 1956, p. 232) concerning identification of the island; Low Island d is Halfway Island of modern maps. Fig. 1.]

Prince of Wales' Islands Island e [Good's Island of Flinders, Fig. 3]

No I Composes the greater part of the hills & rocks examined with some slight variation of grain

[No specimen]

No II Weather worn specimen of No I &[?] *a small specimen of Mountain Green found encrusting wet rocks*

[No specimens. Flinders (**2**, 120) noted *streaks of verdegrease, as if the cliffs above had contained copper ore* at one place on Good's Island. Brown (diary, 2 Nov.) wrote of *a very thin drusy-covering of Green oxyde of copper on some rocks in a cave near the shore.*]

Gulf of Carpentaria [Fig. 3]

Coen River [6 November]

Calcareous sand stone

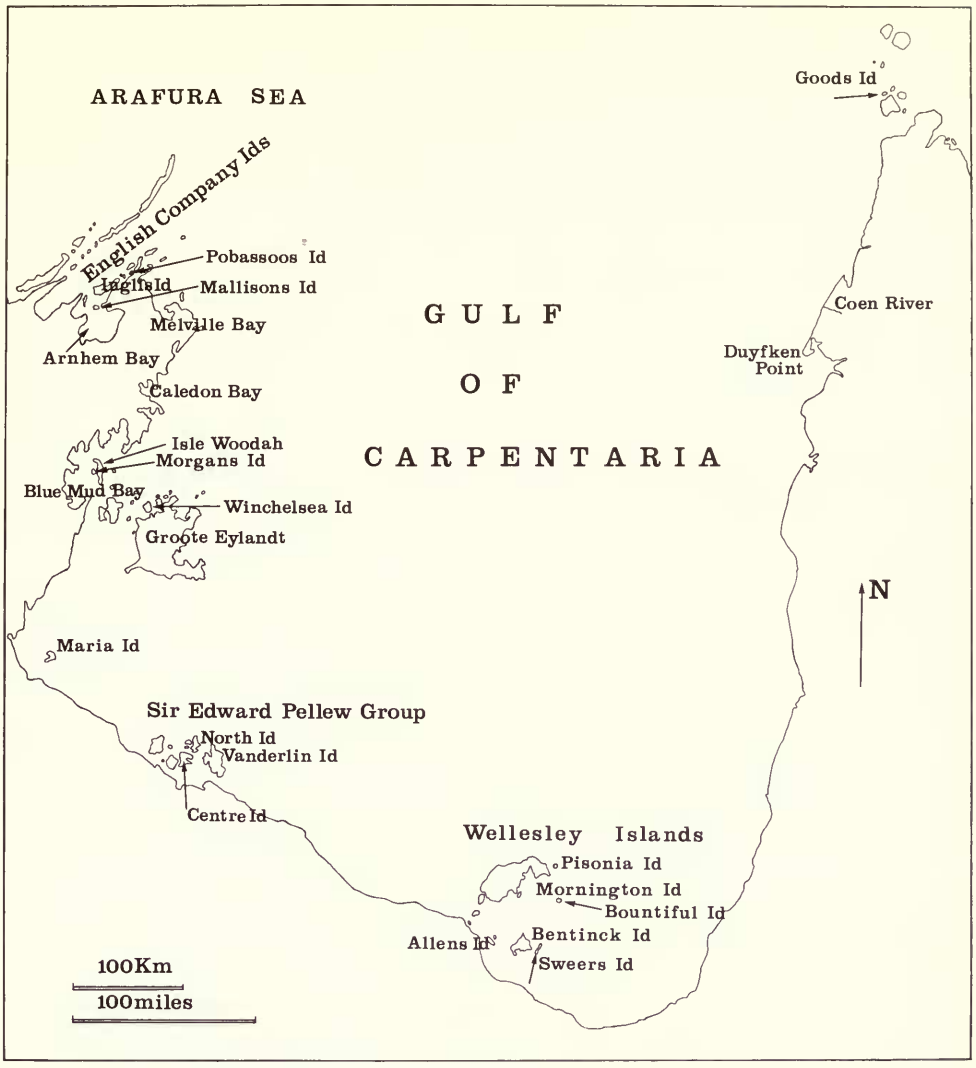

Fig. 3 The Gulf of Carpentaria, including some of the collecting localities. December 1802–March 1803.

Island a (Sweers' Island Flinders) [—added later] *Lat* [blank] *Long* [blank] *Nov^r 17 1802*

No I covering ~~thickly~~ the small hills opposite to the ship ~~rugged~~ & so thickly ~~set~~ that walking in many places was rendered extremely difficult seldom rising to more than a foot in height amorphous ragged—no distinct ramifications

[BM 75806 and 1911, 1545(1). original label—with 75806: *Carpentaria Island a No 1 41)* Refs: Flinders, **2**, 134; Brown and Good diaries.

The obscure remarks in the catalogue are clarified in Brown's diary:

The island itself is undoubtedly of very recent formation the hill abreast the ship about perhaps 50 or 60 feet above sea level was cover'd with an arenaceo-calcareous stone in such a manner as to give at first sight an idea of coral in its natural position, no traces however of organization was observable in it. The material was once a sand, of quartz, organic and lithic grains. It is cemented by calcite, especially so adjacent to open channel-ways or pipes—these, on eroded surfaces, no doubt contribute the pseudo-coralline character. The

two samples have been broken from the same original specimen. Collected at the S end of the island, the material represents what is mapped as Quaternary calcarenite, shelly quartzose sand on Sheet SE 54-6, Burketown, Queensland, 1 : 250 000 series.]

No IIα Forming low shelving rocks in several parts of the Island
[No specimen]

No IIβ differs from No IIα in being softer—with α
[No specimen]

No IIγ differs in having larger water worn pebbles
[No specimen]

No III Forming a steep bank about 10 feet high near the beach abreast of the anchorage
[No specimen]

No IV Forming low rocks cover'd at high water
[No specimen]

No V scatter'd on the surface in various parts of the island
[No specimen]

Island b /Bentinck Island/ [—added later]
Nov^r 18—1802

No I forming low flat rocks containg iron stone
[BM 75808 original label: *Carpentaria Island b No 1 46)* Refs: Flinders, **2**, 136; Brown diary.
A yellowish-brown quartz sandstone probably from the Lower Cretaceous Normanton Formation, this material seems to have been encountered also on nearby Sweer's Island (Brown diary). Only *a piece of Talk(?) . . . cut apparently by a sharp instrument* provided mineral variety for Brown on Bentinck Island. Sheet SE 54-6.]

No II contained in No I
[BM 75807 original label: *Carpentaria Island b No II*
The sample is part of a ferruginous (limonitic) concretion in sandstone, presumably of the Normanton Formation.]

No III a considerable distance from the beach. loose on the surface of various sizes
[BM 75810 and BM 1911, 1545(3) original label (with 75810): *Carpentaria Island b No 3 48)*
Registered as an ironstone, the sample appears to be a lateritized sand crudely pisolitic in character. It is probably from a fossil soil on the Cretaceous sandstone.]

No IV Low flat rocks on the shore
[No specimen]

No V near No IV forming similar rocks on the surface
[No specimen]

No VI forming low flat rocks on the shore
[No specimen]

Island c (Allen's Island) [—added later]
composition the same as a and b

Island f = /Turtle Island/(Bountiful Islands) [—added later]
Dec^r:—[3–4] *1802*

No I On the beach in blocks—
[No specimen]

No II In large blocks on the shore
[No specimen]

Island e = /Pisonia Isle/ [—added later]
Dec^r: [6] *1802*
Compos'd of calcareous breccia & fine pudding stone

Island h (North [/] ~~*Vanderlins Island*~~ [—added later]
Lat : [blank] *Long :* [blank]
Dec^r : 16–25—1802
No I Composes the Island with some slight variation of grain & hardness. forming in several parts of the shore abrupt but not very high cliffs, full [of] *wide cracks & here & there containing small caverns*
[No specimen]
No II On the shore west side of the Island near the place where the mangroves are cut down
[BM 1911, 1545(2) label: *Carpentaria North Island No 2 Island h* Refs: Flinders, **2**, 166; Brown diary (20 Dec. but, in fact, 19 Dec.).
A pisolitic ironstone or laterite. In the diary, Brown noted nothing geological apart from the fact that sandstones occupied the middle of the island. Sheet SD 53-16, Pellew, Northern Territory, 1 : 250 000 series, is not available. This specimen is one of a group Brown gave W. H. Fitton about 1826; it is strange that no duplicate was preserved, and that Brown failed to record the occurrence of ironstone on North Island, one of the Sir Edward Pellew Group.]
No III Beach abreast of the anchorage, small rocks
[No specimen]

Island h4 Dec^r 21—1802 [off Centre Island?]
Compos'd of Sand Stone in some places schistose as in specimens marked B—
[No specimens]
No II Small Rocks on the shore
[BM 1911, 1545(4) label: *Carpentaria Island h-4 Dec^r 21^st 1802* Ref: Brown diary (for 20 Dec.)
The sample is a porous coralline limestone with some small sparry patches. The data are puzzling; Island h4 has not been found on Flinders' chart. On 21 December Brown remained aboard the *Investigator* and Good that day accompanied Flinders to Craggy Island (Good diary, 21 Dec.; Flinders, **2**, 167) but says nothing about rocks. At this period, Brown again had trouble keeping time. If he collected this sample it must have been on 20 December. He landed then for an hour on a small island off the eastern coast of Centre Island. From that inspection Brown adjudged the island to consist of sandstone. The present sample may be from the remains of an old fringing reef.]

Island g (Vanderlin Island) [—added later]
3 hummock part where we landed on the 14^th Dec^r is compos'd of sandstone but where we landed & apparently in other ~~*places*~~ *parts of the shore there are very large blocks some of them loose on the surface of Calcareous grit*
Other parts of the Island after wards examin'd on Dec^r 19 & 25 exactly similar to Island h
That is compos'd of SandStone with here & there on the shores fragments of Iron Stone
[Between 21 and 25 December, Brown made no daily entries in his diary but his note of a visit to Island g (Vanderlin Island) on 25 December agrees with Good's account. Of the place Brown added:
The stone is the same precisely as that of Island h (North Island).

Island l (CapeMaria) [—added later, but now known as Maria Island]
Jan^y 1—1803
Island principally compos'd of Sand Stone—
No I Petrosilex? containing minute crystals found loose on the shore in flat pieces about 200 Lb : not frequent
[BM 75812 and 1911, 1545(6) original label (with 75812): *Carpentaria Island L 54)* Refs: Flinders, **2**, 179; Brown diary (1 Jan.).
The specimens are from a plate of cream-coloured chert with irregular cavities lined with small crystals of quartz. Sheet SD 53-11/12, Roper River/Cape Beatrice, Northern Territory, 1 : 250 000 series, reports the presence of cherts in the Yalco and Lynott Formations

of Proterozoic age; both formations appear on the island near the landing place, some 2 miles W of the SE corner of Maria Island. The two pieces fit together exactly but do not complete the original; a third part is missing.]

No II in the bed of a small rivulet near the landing place
[No specimen]

No III In slate like loose fragments 2 or 3 feet diameter, a few inches thick, on the beach
[No specimen]

No IV with N° III in pieces nearly the same size
[BM 75809 and 75811 original label (with 75809): *Carpentaria Island l No 4 47)*
The material is a deeply-leached platy siltstone or slate, almost white and marked by dendritic growths of vernadite (hydrous manganese oxide) and joint-fillings of the same black material. The original sample must have been broken and the parts separated before registration of the collection. At that time one of the labels was mis-read and another locality then assigned to part (75809) of the sample.]

Main land opposite Groote Eyland
arenaceo-calcareous [rocks] *on the shore*

Cavern Island (Chasm Island) [—added later]
Sand stone vid Groote Eyland
Cavern Island l ~~(Winchelsea Island)~~ [—added later]
[If a specimen was taken it is not preserved]

Groote Eyland Jan^y 15—1803
No I Common appearance of the Sand stone of which this part of the Island consists
[BM 1911, 1545(5) label: *Carpentaria Groote Eylandt No 1 8)* Refs: Flinders, **2**, 190; Brown diary (15 Jan.).
A fine-grained reddish quartz sandstone, collected just N of North West Bay, Groote Eylandt, opposite Finch Island (Sheet SD 53-7/8, Blue Mud Bay/Port Langdon, Northern Territory, 1 : 250 000 series). This and the following come from the Proterozoic Groote Eylandt Beds.]

No 2 Sandstone with numerous angular fragments small pebbles of quartz not uncommon in large blocks on the top of the bluff head near which the boat landed
[BM 75805 and 1911, 1545(5a) original label (with 75805): *Groote Eylandt No 2 Jan^y 15 1803 39)*
The material is a pink quartzite formed from a quartz-rich gritstone with sporadic pebbles by deposition of secondary silica.]

Island p (Winchelsea Island) [—added later]
Jan^y 16 1803
No I Sand stone which composes the island as far as seen, similar to that of Groote Eyland
[BM 75817 original label: *Carpentaria Island p N° 1 Jan^y 16—1803* Refs: Flinders, **2**, 190; Brown and Good diaries (16 Jan.).
Good, Allen and Bauer went ashore this day; Brown remained on board. The sample is a quartzite derived from a coarse quartz sandstone; quartz overgrowths on sand grains in many places have enlarged to replace all matrix. Good remarked that *the Rock here is chiefly freestone of different degrees of hardness.* Such variations result from the extent to which silicification has proceeded in the Groote Eylandt Beds here.]

Island ql (Bustard Island) [—added later]
[Brown landed on the island (18 January) and saw it was composed of sandstone (diary).]

Island r (Burneys Island) [—added later]
[Visited by Brown on 19 January; the island *compos'd of sandstone in the middle* (diary).]

Island s (~~Woodah~~ Morgans Island) [—added later]

No I Argillaceous stone composing the island sometimes rudely columnar breaking in large cubical fragments containing veins of quartz

[BM 75814 original label: *Carpentaria Island s Jan^y^ 1803 No I Var 2 62)* Refs: Flinders, **2**, 198–199; Brown diary (21 Jan.).

Rocks compos'd of argillaceous stone resembling basalt in some cases somewhat columnar in all splitting into cubical or rhombic fragments. Thin veines of quartz & these but rare in some places the rock in them nearly perpendicular strata (Brown). Most of Brown's (and Good's) record of the day deals with Westall's and Allen's encounters with natives and the spearing of the Master's mate, etc.

The mid-brown coloured sample is a feebly-metamorphosed mudstone; it has a cleavage and this with distinct cross and diagonal joint systems determines the shapes of fragments observed by Brown. The island was approached from the east and the first rocks to be encountered would belong to the Lower Proterozoic Grindall Metamorphics (Sheet SD 53-7/8). This sample may be from that source or perhaps more likely from the Groote Eylandt Beds that lie beneath most of the island.]

No 2 Specimen of No 1 with quartz veins, not uncommon

[No specimen]

No 3 forming rocks in a gully towards the North side of the Island

[BM 1911, 1545(7) label: *Carpentaria Morgans Island No 3 Island S*

In addition to the argillaceous rocks, Flinders (**2**, 199) noted sandstones *with a mixture in some places of iron ore, but more frequently of quartz* on Morgans Island. The two pieces bearing the above number are purplish-brown clastic rocks from the Groote Eylandt Beds; the smaller piece is of a quartz sandstone with an iron-stained argillaceous cement, the other is similar but coarser—more like a gritstone.]

No 4 Top of the Island, forming pretty large flat masses loose on the surface

[BM 75813 and 1911, 1545(9) original label (with 75813): *Carpentaria Island S Jany 21 1803 No 4*

The two samples are not from the same specimen though both are gritstones or fine conglomerates with small well-rounded quartz pebbles in a sandy/argillaceous matrix. Both show bedding features to which the platiness is related; they are from the Groote Eylandt Beds.]

No 5 Sandstone on top of the Island in thin strata

[BM 1911, 1545(8) label: *Carpentaria Morgan's Island No 5 Island S*

A reddish-brown and even-grained quartz sandstone, somewhat friable, it is derived from the Groote Eylandt Beds.]

Point T of the Main
Jan^y^ 26 (Cape Shield) [—added later]

Point S of the main Point Blane [—added later]
Jan^y^ 28th 1803

No I forming low rocks on the shore no other kind of stone (varities of this excepted) seen on this point

[No specimen]

Round Head [Round Hill Island, Blue Mud Bay]

Arnheim South Bay Caledon Bay [—added later]

No I Grey Granite of which a few blocks just above the surface seen not far from the tents of the North East side of the bay

[No Specimen]

Point U_1 (Mount Caledon) [—added later]

grey granite similar to No 1 composes the hills of this point

[BM 75815 original label: 63) *Composing the Hills of Point U_1 Feby 6—1803* Refs: Flinders, **2**, 207 ff; Brown diary (5 Feb.).

The specimen is a medium-grained biotite-muscovite-hornblende adamellite, light grey in colour and moderately fresh despite chloritization of the biotite. Graphic intergrowths of quartz and alkali feldspar are typical. The material represents the Lower Proterozoic Caledon Granite (Sheet SD 53-3/4, Arnhem Bay/Gove, Northern Territory, 1:250 000 series).]

Island V_1 off Cape Arnheim

Composd of Grey granite grain coarse, I observed no veins of quartz or of sienite but one remarkable vein of a finer granite about $2\frac{1}{2}$ or 3 inches thick—in one place—

[No specimen; Brown's remark about the island being off Cape Arnhem is incorrect. Island V_1 is the present Dudley Island (visited 10 Feb.), in front of Caledon Bay.]

Arnheim North Bay [Melville Bay of Flinders and modern maps.]

No I small graind greyish granite with thin quartz veins on the hill nearest the ship (Point Dundas) [—added later]

[No specimen]

No II Coarse-graind grey Granite composing the greater part of the hills examind & the blocks exposd in the neighbourhood of the anchorage, of this there are also larger pieces not packed in paper

[BM 75820 original label: *Arnham North Bay No 2 Feby 14 1803 89)* Refs: Flinders, **2**, 224–5; Brown diary (13–14 Feb.)

A rather weathered granodiorite with large (to c. 25 mm) subrounded ocelli of feldspar surrounded by darker patches or trails of biotite and some pink garnet, the rock matches the Bradshaw Granite (? Archaean) mapped on Sheet SD 53-3/4. This specimen was probably taken in the vicinity of Drimmie Head.]

No III Oxyd of Manganese? Small island in North Arnheim Bay. large specimens of this unpack'd (Melville Island) [—added later]

[BM 75818 no original label (but that with 75819 may belong) Refs: Flinders, **2**, 224; Brown diary (16 Feb.)

This colloform mass of pyrolusite (Plate 1, *Top*), one side smooth and containing admixed goethite, the others rough as broken from a larger body or outcrop, is of especial interest in view of recent commercial exploitation of manganese in the region. On 16 February, Brown (diary) accompanied Flinders *on a boat excursion to the more distant parts of the bay* [Melville Bay]. *Small island landed on contains much manganese?* Flinders, that day, reported visiting an isthmus, some 3 miles E of Drimmie Head, where mangroves grew *on rocks of strongly impregnated iron stone.* Isthmus may have been island (though certainly *not* Melville Island) and iron stone a manganese oxide but, in any case, it is strange that Brown did not appear to divulge his opinion about the manganese.

Later, Flinders (**2**, 245) came to think a zone of ironstone extended across the whole NE corner of Arnhem Land and including this deposit in Melville Bay.

In Brown's Catalogue, No III (above) completes the list of samples from Melville Bay. There is, however, another specimen in the BM(NH) collection taken during the visit of *Investigator:*

BM 75819 original label: *Arnham North Bay Island* [blank] *88) Feb 16—1803*

Refs: Good diary (14 Feb.); Brown diary (16 Feb.)

The specimen consists of a group of broken, clear to slightly milky quartz crystals with some weathered granite or cemented sand and iron oxide attached. Brown mentions *perfect crystalls of quartz* in the same passage as the manganese oxide just listed but as the quartz is not in his catalogue we think the present sample may not be his. Good (14 Feb.), in fact, disclosed that Flinders, Bauer and Westall found quartz crystals *in Caverns* [?cavities] *in Ironstone & Granite.* If the sample was collected then, the original label here may really belong to 75818, which was collected by Brown on the day stated. Despite that uncertainty, there is no doubt the crystals were collected at Melville Bay; the matrix, in fact, makes that clear. A piece of quartz, registered as BM 75776 and

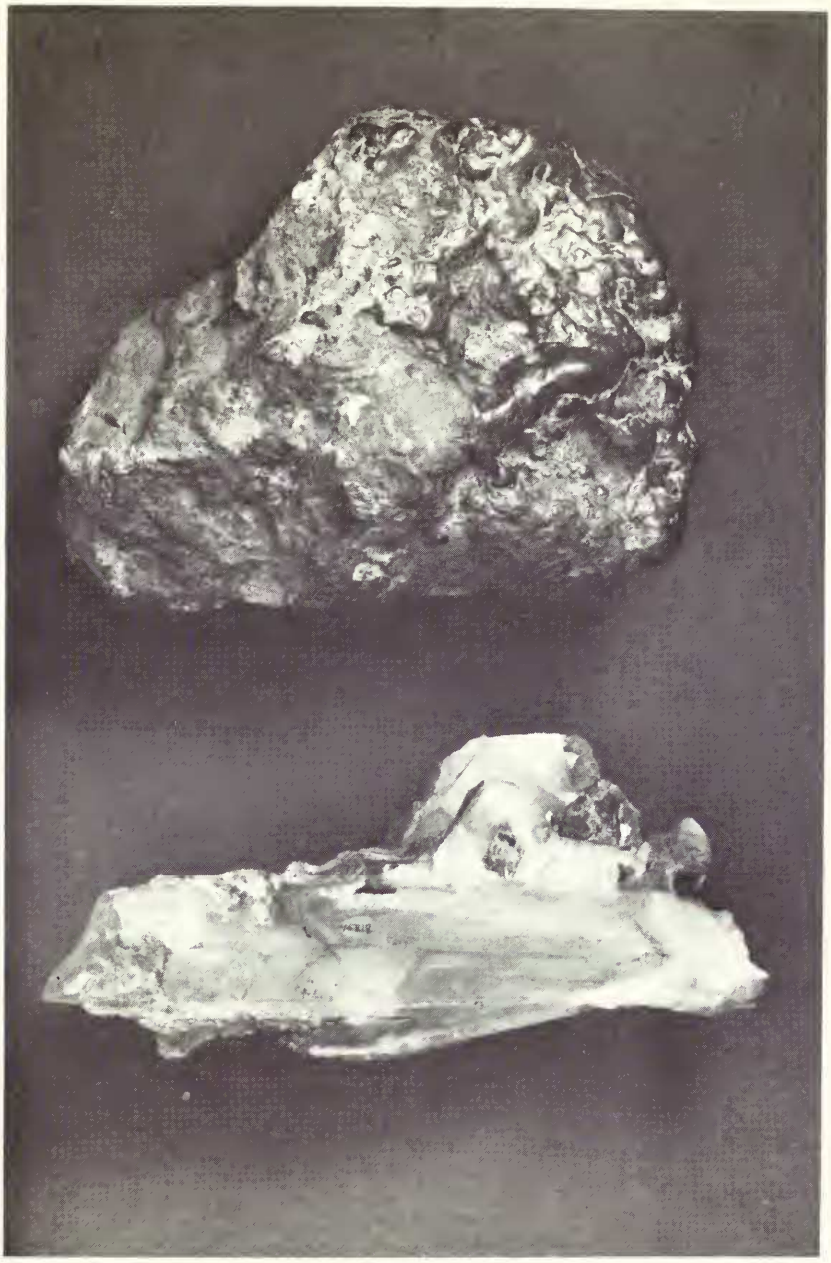

Plate 1 *Top*: A colloform mass of pyrolusite and goethite collected from an island in Melville Bay, Gulf of Carpentaria, during the *Investigator* voyage. BM 75818. *Bottom*: Quartz, from Melville Bay, Arnhem Land. Part of this specimen was illustrated in Edwards (1976). BM 75819. The specimens are about two-thirds natural size.

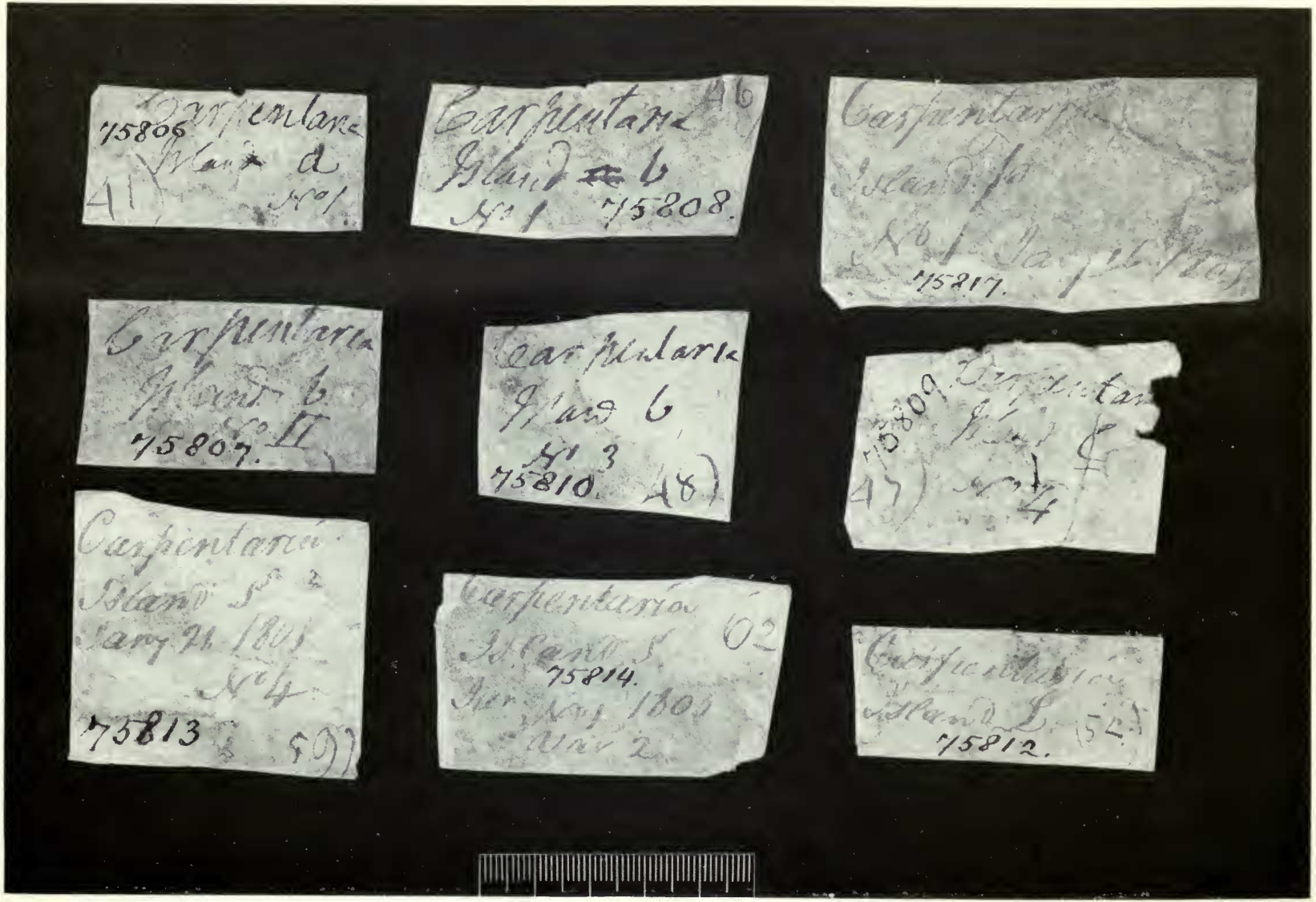

Plate 2 Some original labels associated with specimens from the Gulf of Carpentaria leg of the *Investigator* voyage which suggested that the specimens were from 'Carpentaria Island'. The true provenance of these specimens is discussed in the text. The five figure numbers are additions given by the British Museum (Natural History) in the 1890's when the collection was registered.

assigned to a locality at Keppel Bay, (p. 13) fits a broken end of BM 75819 (illustrated in Edwards, 1976, Pl. 4); the two pieces are now united (Plate 1 *Bottom*).]

North Coast
Island y_2 */Pobassos' Island/* [—added later]
Feb^{y} *18—1803*
No I Sand Stone composing the greater part of the Island
[BM 75804 original label: *North Coast Island y.2* Feb^{y} *18—1803 No I 34)* Refs: Flinders, **2**, 235; Brown and Good diaries.
Good described the island as *very hilly & full of Stones, which are grit stone & in Some places a kind of Slate stone.* Brown saw it as composed *of an argillaceous stone.* The sample is an even- and fine-grained grey quartz sandstone or rather, from the extent of secondary silicification, a quartzite. We note that the Upper Proterozoic Wigram Formation, containing massive grey fine sandstones (Sheet SC 53-15/16, Wessel Islands/Truant Island, Northern Territory, 1:250 000 series), occupies that part of the island facing *Investigator's* anchorage. The description is appropriate to this specimen.]
No Iβ softer variety of the former
[No specimen]
No II In a gully about half a mile from the anchorage
[BM 75802 original label: *North Coast Island y.2 Feby 18-1803 No 2 32)*
The sample is of an olive-green siltstone, distinctly jointed across and along bedding planes. The rock appears to come from the Pobasso Formation (Upper Proterozoic).]
No III in flat blocks left dry at low water, abreast of the ship granite dark grey, fine grain'd
[BM 75803 and 1911, 1545(11) original label (with 75803): *North Coast Island y. 2 Feb*^{y} *18, 1803 No 3 33)*
None of our observers (Flinders, Brown and Good) saw fit to comment on this rock, a quartz dolerite from the sill of Proterozoic age that crops out along the E shore of Pobasso Island. Under the microscope this fresh rock displays interstitial graphic intergrowths of quartz and alkali feldspar; brown hornblende and biotite occur in addition to abundant pyroxenes.]

Island y1 (Cottons Island) [—added later]
Feb^{y} *20—1803*
No I forming the upper part of the cliff which we ascended on the 20th
[No specimen]
No II forming the greater part of the island = {white sandstone}
[No specimen; Cotton Island consists of the same geological units as Pobasso Island. The place deserves remembrance as the subject of one of Flinders' rare light touches (**2**, 235–236).]

Island y_3 *(Astells Island)* [—added later]
Feb^{y} *21—1803*
No I Sand stone comprising the rocks on the island
[No specimen; Sheet SC 53-15/16 indicates the island as consisting largely of the Astell Sandstone, the unit next above the Pobasso Formation in the Upper Proterozoic succession of the region.]

Island y z (Inglis Island) [—added later]
No I In flat beds on the shore
[BM 75801 original label: *North Coast Island* [blank] *Feb*^{y} *24, 1803 No I 30)* Refs: Flinders, **2**, 237; Brown diary (24 Feb.)
The specimen is a dark grey argillaceous rock with a marked parallel fracture, probably a bedding cleavage rather than slaty cleavage. It seems to be more consistent with some

members of the Wigram Formation but the cove at the northern end of the island where Brown landed is beset by the stratigraphically-higher Pobasso Formation (Sheet SC 53-15/16).]

No II Small block loose on the surface on the hills near the shore

[No specimen]

Bosanquet's Island Stone like that of Inglis Island [—line added later]

Island α March 1 1803 (Mallison's Island) [—added later]

No I Comprising the upper part of the perpendicular cliffs & tops of the hills, occasionally as in this specimen marked with Copper /?/ ore

[BM 75800 original label: *North Coast Island α Mar 1 1803 No Iα 28)* Refs: Flinders, **2**, 241; Brown diary (1 Mar.) A quartz sandstone, generally pink but passing to grey next to joint surfaces coated with iridescent, botryoidal goethite. The latter must be what Brown took to be copper ore. The sample is from the Upper (?) Proterozoic Mallison Sandstone (Sheet SD 53-3/4).]

No Iβ variety of the former

[No specimen]

No II forming the lower part of the perpendicular cliffs

[BM 75799 original label: *25) North Coast Island α No 2 Mar. 1 1803*
A dark grey laminated mudstone, affected by some diagenetic or low-grade metamorphic recrystallization of micas and formation of poikiloblastic spots, the sample comes from the Lower(?) Proterozoic Wilberforce Beds forming cliffs along the S shore of Mallison Island. Flinders (**2**, 241), noting the black cliffs as he approached the island, thought he would find coal there.]

No III In loose blocks at the bottom perpendicular cliffs

[No specimen]

No IV with the former, a variety of No I

[No specimen]

Point y2 of the main (South side Cape Newbald) [—added later]
March 3d 1803
composd of similar stones took the following [blank]

Island α1 ~~Cape~~ Red Cliffs [—added later] *March 4*

No I at one end of the red cliff No II

[No specimen]

No II forming red cliffs moderately high in many places much softer

[No specimen; Brown (diary, 4 March) noted the red cliffs on the mainland (opposite Cape Newbald) to *consist of siliceous sand or ochre.* On Sheet SD 53-3/4 the area is mapped as covered by Cainozoic laterites, etc.]

New Years Island North Coast March [12] *1803*

Coral but little changd composing the Island, at least no other stone seen on the surface—Mr Good

[No specimen, if one was collected. Good (diary, 12 March) reported: *The whole Island is composed of Coral & sand & shells and some lakes of Salt water with mangroves.* See also Flinders, **2**, 249.]

Island of Timor Coopang Bay
April 1—7th 1803

No I found loose in the bank of the Rivulet a little above the town—of Coopang

[No specimen]

No II Rocks in the bed of the River a little above the town of Coopang

[No specimen]

No III near the River one piece only seen marmor—

[No specimen]

No IV Calcareous Rock composing the hills above Coopang the cliffs on the shore The rock on which the fort is built containing shells not uncommonly
[BM 75821 and 1911, 1545 (10) original label (with 75821): *Timor No 4 (3;* label with 1911, 1545 (10): *Carpentaria Round Head*
The disparate labels relate to two pieces that fit together exactly (now reunited) leaving, as has been noted in a few other cases, clear evidence of a third part still missing. Round Head, mentioned in Brown's catalogue (p. 23) but not by Flinders, must be Round Hill Island in Blue Mud Bay on the eastern shore of Arnhem Land. Fitton (King, 1826, **2**, 611) offers remarks on Round Head but these seem to combine a published report concerning the nearby Cape Grindall (Flinders, **2**, 202) with an observation on the present specimen. Fitton terms this rock *a calcareous, probably concretionary stone, enclosing the remains of shells, with cavities lined with crystals of calcareous spar.* However, we can find no evidence anyone from *Investigator* actually landed on Round Hill Island and conclude that Fitton was misinformed by Brown. If one of the labels is appropriate, it is the one indicating this heterogeneous limestone, in part compact, in part cavernous and sparry, was collected at Koepang, Timor.]

The catalogue shows how faithfully Brown and his party followed Banks's directions. Their geological work rarely passed the level of collecting. Access to the specimens, however, enables us to grasp the scale of collecting in terms of lithological variety. For the first leg that was not possible as Brown's catalogues, by themselves, are not especially informative. Often he listed no more than a number and a locality (and a vague locality at that). General localities may serve a botanical collector; they are less helpful to the geologist. With the specimens and modern geological maps it has been possible to recognize not only the situations from which the samples were taken but to discover that Brown's collection is reasonably representative of the rocks he and his party would have encountered. Within the limits set for their work, the achievement is creditable.

It is also possible to glimpse, from the records of the second leg of the voyage, something concerning the efforts of John Allen and Peter Good in regard to geology. If Allen remains in the shadows the activities of 15 September 1802 indicate his ability to reach independent conclusions in the identification of rocks. That Flinders attached Allen's name to an island on his map of the Gulf of Carpentaria must be a sign that the miner had proved himself useful. Good's contribution is much easier to recognize. His diary is a model of careful record, stocked with notes about rocks as well as plants. On many occasions he worked away from Brown, by himself, or with Allen, or one of the artists. Good emerges as a competent naturalist in his own right. He was far more than a gardener and Brown's botanical assistant; his death on 12 June 1803 just after *Investigator* returned to Sydney must have been a severe blow to the scientific effort.

Before leaving the second stage of the voyage, it is necessary to consider Flinders and his geological work. We have no idea what specimens he collected, apart from the few pieces given to Brown, but Flinders's text betrays his interest. Geology was to be a source of intellectual diversion during his years of imprisonment on Mauritius. Beset with the problems of navigating and charting dangerous waters, Flinders had even less opportunity than Brown to discover significant stratigraphical relations along the Australian coast yet in two broadly geological fields he made observations that were to attract wide attention. They were the nature of coral reefs and terrestrial magnetism, perhaps obvious interests for a navigator with a scientific bent. His magnetic observations, compiled in his captivity, found a place in the *Philosophical Transactions of the Royal Society* (1805, **95**: 186–197) and were the first scientific fruits of the expedition to be published. Though never elected to fellowship in the society, Flinders won a favourable reputation among scientists. For the last few years of his life, he enjoyed a place in the Wernerian Natural History Society in Edinburgh, a body presided over by Brown's friend Robert Jameson. The connection for Flinders must have been a little incongruous; his belief in the efficiency of subterranean heat as a cause of geological action was hardly Wernerian (Vallance, 1975, p. 23).

Flinders's study of the Australian coral reef system began in about latitude 20° S and culmi-

nated with observations of the fringing reefs at Halfway Island in what he termed the Corallian (now, Coral) Sea and the reefs along Pandora Passage leading into Torres Strait (Flinders, **2**, pp 87–89, 114–116, 336). He was particularly interested in the morphology of the reefs and the manner in which the banks accumulated. There is something in Flinders of the 'instinctive' model espoused by J. R. Forster (1729–1798), naturalist to Cook's second voyage round the world, after examining some of the low islands of the Pacific Ocean. Flinders had no greater appreciation than Forster (1778) of the zoological aspects of coral growth; both seem to have thought the organisms simply fulfilled their destiny by constructing ramparts. Emergence of the reefs followed that inexorable growth, modified from time to time as the sea attacked the structure and redistributed calcareous rubble. It was a remarkably non-catastrophic view. Jameson (in Cuvier, 1822, pp 325–328) quoted extensively from Flinders in his notes on coral islands. Others also cited him and though twenty years later Flinders's ideas were set aside, Darwin (1842) still relied on his charts and descriptions. The work of Flinders gave a starting-point for the geological investigations of J. B. Jukes (1811–1869) on the Great Barrier Reef of Australia during the voyage of H.M.S. *Fly* (Jukes, 1847). On the *Investigator*, it had been a job for the commander. Flinders's little known communication of January 1807 to the *Société d'Émulation* on Mauritius (Flinders, 1810) includes general notes on the Australian reefs as well as a particular record of his experience of Wreck Reef.

The Stay in Australia June 1803–May 1805

When the ramshackle *Investigator* reached Sydney and Flinders had announced his intention to seek another vessel in England to complete the survey, Brown sought permission to remain and extend his work while the commander was absent. Applying to Flinders by letter dated 13 July 1803 (BL Add MS 32439 ff 98–99) on his own and Bauer's behalf, Brown explained how much more usefully they could be employed in the colony. A postscript to the letter requested similar permission for Allen. Brown pointed out that Allen 'might . . . be usefully employ'd especially in the more remote & mountainous districts of the Colony & that he would be a valuable assistant to me in my excursions'. Permission came four days later but Allen soon changed his mind.

> Mr. Allen who was at first inclin'd to remain & was therefore included in my letter has since, from a well founded apprehension of incurring great expence, requested to go home & as the department to which he belongs has hitherto afforded us so little I think he has judg'd very wisely—[so Brown told Banks in his letter of 6 August 1803]—(BL Add MS 32439 ff 104–108).

Despite his request to stay, Brown went on in the letter to express disappointment with the voyage: 'Mineralogy has been uniformly a barren field & even Botany has fallen short of my expectations'. He wrote to Greville the same day in like vein (BL Add MS 32439 ff 117–119/121–124). With conscious or accidental ambiguity, Brown told Greville 'Mr. Westall with whom professionally I have nothing to do & Mr. Allen the Miner who is really of very little use go home on the Porpoise'. He explained that 'Botany I have all along made my chief study & in consequence of our very short stay at many of our anchorages the other departments were sometimes in a great measure overlook'd'. Greville was also told Flinders did not rate Brown's collections highly enough, that he had failed to provide proper boxes, and so forth. It would be intriguing to know if Flinders was not at times irritated by Brown's narrow devotion. But to return to the letter, having complained about the dullness of Australian minerals (rocks), Brown finished by remarking that a number of the books he wanted had not arrived. Among the titles was 'Hauys Systematic work on Mineralogy', one soon to be unexpectedly appropriate. Within the year Brown would be working in the company of a mineralogist who owed his appointment to Greville's interest. This period of Brown's activity is not well-known; for that reason we treat it in rather more detail than the earlier stages.

The *Porpoise* left Sydney in August 1803 before all the natural history collections had been packed. Indeed, it is far from clear what actually did go at that time. One set of Brown's plants

certainly was destroyed (BL Add MS 32439 ff 134–135) but as he had kept duplicates the loss was not irreparable. We know that Flinders' collection of rocks went and assume Brown's rocks from southern Australia were lost on the reef. It is not recorded if Allen had any responsibilities towards care of the collections on board. Allen himself went on to China with other survivors from the *Porpoise*. There he took passage 6 February 1804 on the Indiaman *Henry Addington* (India Office Libr., London. Ships' logs L/MAR/B/170C) from Wampoa Reach, Macao, in a convoy of some twenty ships among which the men of the *Porpoise* had been distributed. We know that Allen landed at Brighton 8 August 1804. All trace of him ends with a letter dated 30 August from Banks to Brown (BM (NH) DTC **15,** ff 84–85) mentioning Allen's return and that he had brought news of Good's death. There is nothing about Allen's work, nothing about rocks; it is assumed he returned unencumbered and that no geological collections reached England until 1805. During his stay in Australia, Brown twice sent consignments of specimens to Banks but these were exclusively botanical. Any rocks left behind in August 1803 must have returned with Brown in October 1805.

Brown stayed in and about Sydney, botanizing and arranging his collections, until an opportunity to travel southwards to Bass Strait presented itself. It had been resolved to make a new settlement in that region under a lieutenant-governor, David Collins (1756–1810). Collins set up a camp on the mainland near Port Phillip and established communication with Sydney. The *Lady Nelson*, with Brown as a passenger, left the mother colony at the end of November 1803 carrying messages for Collins. Bad weather in the strait forced her to seek shelter and Collins became alarmed when she failed to arrive. Already convinced the camp was unsuitably situated, Collins decided to combine a search for the *Lady Nelson* with a reconnaissance of the opposite side of Bass Strait. By chance, the schooner sent out by Collins had also to run for shelter in the Kent's Group and there found *Lady Nelson*, which was promptly engaged to convey the search party to Van Diemen's Land. Brown remained on board and so came to witness the beginnings of European settlement in Tasmania.

The death of Good and Flinders's departure had removed the diligent diarists. Brown's subsequent record is quite erratic and, in places, misleading. For instance, he dated his departure on *Lady Nelson* as 1804 instead of 1803, a mistake which has led some to think he twice travelled on her to Tasmania. The chance meeting with Collins's party brought together Brown and Adolarius W. H. Humphrey (1782?–1829), H.M. Mineralogist in the colony. Others in London had heard the representations to which Banks was deaf, that a mineralogist be sent to New South Wales. The man appointed went out with Collins. Humphrey's commission, dated 14 January 1803 (*HR Austr.*, ser. 3, I, p. 6), he owed to Brown's correspondent C. F. Greville. His father, George Humphrey, was a well-known London dealer (Whitehead, 1973). For Greville's information George Humphrey prepared a series of extracts from his son's letters (BL Add MS 42071 ff 125–145); these provide necessary supplements to Brown's account.

Sharing acquaintances among the devotees of natural history in London, Brown and Humphrey were to share many experiences in the wilds of Tasmania. But although thus thrown together their relation may never have been especially close. Humphrey, a gregarious type with a distinct inclination to commerce, must have been quite unlike the reserved, even secretive, Robert Brown. Brown has little to say about Humphrey, the return is at once more voluble and respectful. But Humphrey made an impression. Brown resumed collecting rocks. One of his catalogues for this period has been preserved in the Mineralogy Library of the British Museum (Natural History). The manuscript fills $6\frac{1}{2}$ pages of the 8 leaves into which a single sheet (43 × 31 cm) was folded—so many of Brown's notes and lists were entered on such folded sheets—and is entitled: *Collection of Minerals from Kent's Group Dec^r 1803* (cf. Edwards, 1976, p. 402). In fact, after recording four samples from that place the list continues with 18 specimens from Port Dalrymple in northern Tasmania, 2 from Port Phillip and 27 from about the River Derwent. The specimens have not been found but, unlike Brown's previous lists, this one affords means to discover what was collected. It gives rock names, not just localities; here surely is a sign of Humphrey's influence. Brown's new-found lithological fluency found expression also in a unique statement headed *Mineralogy* (BM (NH) Bot. Libr. Brown MS 10 f. 137) near the end of his notes on the plants of the Kent's Group:

Mineralogy
Both Islands are high consisting of rounded hills. They are compos'd of granite mostly grey here & there red: both consisting of Felspar Quartz & Mica rarely containing also black schorl: Mica is either colourless or in the red granite black. sometimes wanting Felspar sometimes found in some crystallizd rhombs. The granite with fissures both vertical and horizontal often presenting the appearance of rude & irregularly jointed columns
The surface of some of the lower hills especially their sloping sides coverd with loose fragments of various: some of considerable size of arenaceous ~~limestone~~ carbonate of lime ([illegible word cancelled by Brown]) not stratified or as far as I could see continuous nor containg marine exuviæ effervescing weakly with acetous briskly with the mineral acids
Several small runs of water in different parts of the Eastern Island but most of them with an unpleasant sweetish taste
Soil on the slopes of these hills that are wooded sandy mixed with vegetable mould brownish not deep very loose in the moist valleys a greater proportion of decayd vegetable matter but these in generally swampy on some of the hills the surface coverd merely with coarse granite sand or grit
Both Islands almost everywhere rise with a steep aclivity from the shore except in the sandy beach of the Island.
In many places they present to the sea perpendicular cliffs of several hundred feet in height
The greatest elevation & at the same time the most precipitous quarter is towards W & SW'

Humphrey's more succinct account (BL Add MS 42071 ff 132v–133r) has nothing about acid tests, though he must have supplied the reagents; Brown did not worry about such things while on *Investigator*.

On 1 January 1804 the *Lady Nelson* reached Port Dalrymple. Brown and Humphrey worked about the estuary and its hinterland until the 19th of the month when the ship left for Port Phillip in preparation for moving the settlement to the River Derwent. There was no lack of variety at Port Dalrymple. Brown noted clay and 'oxyd of iron', pudding stone and micaceous schistus, hornslate and granite among others. Some are unfamiliar terms now, none more so than granitell(e). That word, used by both Brown and Humphrey, turns up among the notes for northern Tasmania and the Derwent. Granitell(e) was a term quickly lost in synonymy, a word applied by H. B. de Saussure (1740–1799) to a substance similar to that already called *syenite* by Werner. Brown and Humphrey evidently applied the name to some part or variant of the dolerites that form large intrusive masses across much of Tasmania. Humphrey, after seeing more of the rock near Hobart on the Derwent, decided that this was

> the Primitive Stone, of which all the Mounts of that nature, I have yet seen in Van Diemen's Land, are composed: It consists of Quartz and Hornblend [Granitell] of a dark olive-green colour; the Hornblend is the least considerable quantity of the Mass; and, where it has been exposed to the Weather, is of a Bronze colour (BL Add MS 42071 f. 139v).

The passage continues with a descriptive sketch of the columnar jointing commonly found in the rock. If we add that the rock in fact consists largely of clear plagioclase and dark pyroxenes, not quartz and hornblende, no criticism is intended. Diagnosis of rock-minerals in the days before thin sections was not very refined. Brown (diary, 14 March 1804) by referring to the Granitell as a greenstone strengthens our equation of this rock with dolerite.

Humphrey literally left his mark on northern Tasmania. In his own words, on 13 January 1804 while water casks were being filled 'I amused myself with carving my name A. H. 1804 in the solid Basaltic Rock (the Rocks named in the Chart *Basaltic*, are composed of *Quartz* and *Hornblend*) with Hammer and Chissel' (BL Add MS 42071 f. 134v). The inscription beside the Supply River is still legible. How splendid it would be if the map also remains; a map dated 1804 of any part of Australia and showing geological detail is a treasure still being sought. There is also the matter of Humphrey's collections; none of them has been traced, yet we know he had, as a perquisite of office, free passage for specimens and sent quantities of shells and 'minerals' to his father. The

sale in May–July 1808 of his late uncle's (Jacob Forster, 1739–1806) stock in trade (some 5860 lots) included a considerable number of shells from New South Wales and Van Diemen's Land many of them possibly from Humphrey junior. Jameson (1811) in a paper read 1809 states, on Brown's authority, that Humphrey was the discoveror of topaz on Cape Barren Island, Bass Strait, and as that mineral sent from Botany Bay (Sydney) became a common article of trade in Britain (Thomson, 1814) Humphrey no doubt contributed to it. The trustees of the British Museum acknowledged a donation on 10 February 1810 of 'Topaz (Crystallized, white) from New South Wales' from Sir Joseph Banks (MS Donations 1756–1876. Keeper's Rm., Mineralogy Dept., BM (NH)); the sample is presumed lost. [Since the above was completed, the correspondence of Humphrey has appeared in print, see Vallance, 1981.]

Not until Brown and Humphrey and their colleagues moved to Hobart Town in mid-February 1804 is there any record of organic fossils. Writing from Hobart Humphrey advised his father (BL Add MS 42071 f. 138) of his discoveries, among them fossil wood from the Coal River. Silicified wood from Van Diemens Land some years later was a common sight at London auctions. After reading Brown's and Humphrey's records, a perusal of the contemporary catalogues leads to a feeling of *déjà vu*. For instance, Lot 3 on the fourth day of Henry Heuland's (1778–1856) sale of May 1812 includes 'Green garnets, New Holland'. Such were found by Brown and Humphrey on their expedition of May 1804 to the Huon River. In Humphrey's opinion 'The principal of my Discoveries on that journey is the Green Garnet in its Matrix, and on the surface of Pitch Stone, and included in it' (BL Add MS 42071 f. 141); Brown had two samples called 'Pitch stone' in his list for 'Vicinity of the Derwent'. That Heuland (Russell, 1950) was another nephew of Jacob Forster increases the likelihood of Humphrey having provided the specimens offered in London. The locality, incidentally, appears to be the present Port Cygnet area.

There is, of course, no suggestion that Brown turned to commerce through his association with Humphrey but the point should be made that material like that taken by Brown did find its way to the London market. Where is it and where, for that matter, is Brown's? Those having the charge of old collections might bear a Micawberish suggestion in mind. Before exploring the Huon River, Brown and Humphrey had sought the source of the River Derwent and made several excursions to Mount Wellington, then called Table Mountain. The flora of the mountain behind the settlement of Hobart Town fascinated Brown; its rocks and those of the foothills had their own interest. He climbed to the plateau top on 18 February when Humphrey was busy helping at the settlement and on that occasion (diary, 18 Feb.) saw marine fossils (he mentions 'Pectenes' and 'coral'—probably bryozoans) in a 'marl' composing 'the round hills on its base'. On 14 March, this time with Humphrey, he again looked at these fossiliferous rocks. Humphrey called the material 'an Argillaceous Stone, having numerous impressions of Marine Shells, &c. on it' (BL Add MS 42071 f. 139). He refers to the place as a 'Secondary Hill, leaning on the Table' which may imply a stratigraphical opinion but, if so, the thought is not developed. Nor is it one to which Brown gave attention. Yet it led in time to a contribution by William Buckland (1784–1856) of Oxford.

Buckland (1821) announced that in specimens collected by Brown in Tasmania and New South Wales, and given him by the collector, he had recognized shelly fossils (from Tasmania) which in his opinion resembled those of the Mountain Limestone in England and plant fossils (from N.S.W.) like some known to occur in the English Coal Measures. Buckland was attempting, on rough palaeontological evidence, a first correlation of Australian strata with those of Europe. It was an interesting result from Brown's reconnaissance but the circumstances have puzzling aspects. Only one sample ('No 16 Composing hills in the neighbourhood of the Derwent sometimes the cliffs on its shores here & there containing impressions of shells') in Brown's catalogue is recorded as fossiliferous and there is no record of fossil plants from his later visit to the Hunter River in New South Wales.

Brown had left Hobart on 9 August 1804 aboard the *Ocean* bound for Sydney and after spending some weeks there set out 11 October for the Hunter River on the colonial schooner *Resource*. His record of that journey and his boat voyages up the river and its tributaries the Paterson and Williams Rivers is rather thin. In fact, the diary ends 4 November with him still at the Hunter River. We know however he visited the coal mines established a few years earlier and

worked by convict labour at Kingstown (the present Newcastle) but there is no mention of seeing fossil plants with the coal. If he collected geological samples and made a list, they are not with his collections at the British Museum (Natural History). What then was the source of Buckland's specimens?

Postlude

Brown's return to England with Bauer on the *Investigator* was mentioned earlier. Bauer, incidentally, had botanized at Norfolk Island while Brown travelled elsewhere in Australia. With them went their collections in 36 packages, including 3 cases of geological specimens—listed in the inventory as Cases XVII and XVIII '{ = half Hogshead} Minerals of New Holland, XIII Minerals & miscellaneous articles' (BL Add MS 32439 ff 183–184). There is no detail as to contents. In his manuscript *General Account of a collection of Natural History of New Holland* (BM (NH) Botany Libr. Brown corresp. 3, 125), Brown claimed he collected four packing cases of minerals. Perhaps the fourth was that we believe lost at Wreck Reef.

Before setting out on the expedition, Brown, Bauer, Westall, Good and Allen had each subscribed to an undertaking drawn up by Banks (*HR NSW*, **4**, pp 349–351) that all collections, notes, drawings etc made during the voyage were to be regarded as public property although any items not so required eventually should be at the disposal of the collector, author or artist. Following the return of Brown and Bauer in October 1805, Sir Joseph Banks (to whose house in Soho Square the collections had been removed from Liverpool) seems to have forgotten the agreement. Everything except the plants and botanical drawings was now to go to the British Museum. In the draft of a letter simply marked 'Jan 1806' and intended for the Secretary of the Admiralty (BL Add MS 32439 ff 237–241), Banks wrote:

> '... if it should be, as it will probably be the case, their Lordships intention & order the Collections finally to be deposited in the National repository of the British Museum, that orders be given for them to Send the Collections of Minerals[,] Quadrupeds[,] Birds & insects to be placed there immediately & arranged by the officers of the house who are fully Competent to do that Business Effectively.'

Earlier in the same draft Banks referred to Brown:

> '... who tho he Profest himself when he engaged in the Service of the Public a Botanist only, undertook at the desire of his Employers to Superintend the Collection of Seeds for the Royal Gardens at Kew assisted by a Gardener who died during the Voyage[.] The Collection of Minerals in which he was assisted by a Derbyshire miner, he [d]id for that Purpose & also the ornithological & Entomological[;] in all which matters, the gardiner & the mineralogist were instructed to assist him.'

The purpose for which the mineral collection was made is not clarified. Banks was not interested and wanted it removed. Why five years elapsed before the Admiralty handed over the collection is a mystery. There is a hollow ring to Banks's apologia for Brown; it was he who insisted on Brown's botanical emphasis, after the association with Hawkins. What Banks really wanted at the beginning of 1806 was an agreement whereby Brown and Bauer could continue in public employment to organize the botanical collection with a view to publication, and in that he succeeded. Thereafter Brown devoted himself to botany, for some years assisting also at the Linnean Society and, after the death of Dryander, as Banks's librarian, right-hand man and, eventually, legatee. With the transfer of the Banksian library and herbarium, the enjoyment of which he had inherited, to the British Museum, Brown became in 1827 keeper of the botanical collection. He continued in that post until his death.

'During his lifetime Brown was never particularly generous with his collections' (Burbidge, 1956, p. 229). That is a botanist's view; his attitude to the rock collections was quite different. Indeed, as we have discovered he was not above damaging specimens already in the British Museum to gratify a friend (or friends). But if Brown cared so little for his geological samples why did he not hand over to the Admiralty (and thus to the museum) all the material he had

collected? Only one donation of *Investigator* material is recorded at the museum (6 April 1811) and from that come the samples described in this study. There is no avoiding the conclusion that Brown handed over none of the rocks and fossils gathered after the departure of Flinders. As to the organic fossils Brown not only kept them aside but did not even include them in the list of his collection; at least they do not appear in any document we have found. From this 'extra' collection must have come the samples disposed of privately to Buckland and, possibly, others. Perhaps it was fortunate that Brown failed to follow the Banksian line of 1806. The samples handed over to the Admiralty were forgotten; among those given to friends, some became a source of stimulation to scientific enquiry.

Buckland's remarks on the coal plants from Australia attracted the interest of the French palaeobotanist Adolphe Brongniart (1801–1876) who recognized two taxa new to science on samples sent him from Oxford. Brongniart (1828, pp 54, 152) introduced the names *Glossopteris browniana* and *Phyllotheca australis*. The former was illustrated and described in more detail by Brongniart (1828–38, **1**, pp 223–224) where it is stated the specimens provided by Buckland were supplemented by others collected in New South Wales by R. P. Lesson (1794–1849). Lesson had visited Australia during the voyage of *La Coquille* (1822–1825). It has long been assumed that the Oxford material was collected by Brown, an assumption based largely on Buckland's statement of 1821 and given circumstantial support by the specific name chosen by Brongniart for the *Glossopteris*. But the evidence remains indirect; no Brown–Buckland correspondence referring to Australian fossils has been found. Examination of the types in the Oxford collection, through the courtesy of Mr H. P. Powell, has not resolved the matter. None of the labels or register entries at Oxford gives any clue to an association with Brown. Furthermore, the locality given for the *Phyllotheca*—'Coal Mine Hawkesbury River near Port Jackson, N.S.W. "à la Nouvelle-Holland" '—is that noted by Brongniart (1828–38). In fact the coal mine was at the Hunter River, nearer 100 miles than the 10 miles north of Sydney that Brongniart claimed. If the samples were collected by Brown, the original information has been thoroughly garbled. All we really know is that Brown did gather fossil plants at the Hunter River, that he did not record the occasion in his diary and that he gave some at least of these 'extra' samples to Buckland. It is no more than likely these were seen by Brongniart.

An even greater problem involves the first Australian invertebrate fossil to receive its own place in the language of palaeontological systematics. This is the brachiopod named *Trigonotreta stokesi* by Konig (1825) and described as 'Ex insula Van Diemen Novæ Hollandiæ In transitionis(?) arenario'; the species name was to honour Charles Stokes (1783–1853) 'nobiscum communicata'. It will be remembered that Buckland (1821) also had invertebrate fossils from Tasmania given him by Brown. Again, these must have been 'extra' samples not recorded in Brown's known catalogues. The original *Trigonotreta* has been attributed to the Brown collection (Brown, 1946, p. vii). It is an opinion held widely and to which one of us (Vallance, 1978) has recently given credence. The case is plausible but far from complete. The specimen itself has disappeared. What remains is a wax model (BM (NH) Department of Palaeontology B 4798) associated in its tray with a BM (NH) label indicating presentation by Stokes. Does the label refer to the model or to the original fossil? Of course, the label cannot be 'original'. The traditional belief is that the fossil was first donated to the Geological Society of London. When did it go missing? Brown (1953) refers to specimen B4798 as the holotype mentioning it as a wax cast but in her description of the holotype she writes as though it was natural. Had she seen the original? It remains a rhetorical question, just as the one how did Stokes obtain it in the first place?

Charles Stokes, described by one who knew him as 'almost a universal collector' (Woodward, 1907, p. 73), was an active fellow and for many years a councillor of the Geological Society, the museum of which he enriched with numerous donations. Among these were several collections, large and small, from Van Diemen's Land (Tasmania) and New South Wales, given in the period 1818 to 1827; they are noted in the society's *Transactions* (ser. 1, **5**; ser. 2, **2**). Further details of some of these collections appear in the so-called *Geological Society Waste Books*, now in the Palaeontology Library (BM (NH)) and transferred there when the society closed its museum in 1911. What remained of the foreign collections was then distributed between the BM (NH) Departments of Mineralogy and Palaeontology. Thus three samples of 'serpentine' from Port

Dalrymple, Tasmania, received from Stokes on 6 November 1818 are now in the Department of Mineralogy registered as 1911.1582(1–3). A much larger collection given by Stokes 15 June 1821 included material from the 'Rev Wm Youl' (no doubt John Youl (1773–1827), colonial chaplain—see *Australian Dictionary of Biography*, **2**, pp 632–3) gathered in Tasmania together with samples related to the explorations of John Oxley (1785?–1828) in New South Wales, though that work is also represented by another set of rocks from an unknown donor. There were a few organic fossils in Youl's collection, which incidentally seems to have been made by another as the heading to the original *List of Minerals for the Rev^{d} W^{m} Youl* suggests. Less than a month earlier (22 May 1821) Stokes had donated ten fossiliferous samples from Tasmania. *Waste Book* 2 (p. 23) records them as two samples of 'Ferruginous sandstone with impressions of leaves', six specimens (three designated 'large' of 'Shell limestone—transition?' and two 'Cast of a bivalve' (one 'large'). Neither specific localities nor collector are named. If Stokes gave the *Trigonotreta* specimen to the Geological Society was it on this occasion? Brown (1946) has claimed so. But unless it was one of the 'casts' (for which no matrix is mentioned) which sample would be likely? The shells here were in limestone; Konig is clear that *Trigonotreta* was in sandstone.

That Stokes acquired Australian material from more than one source complicates the issue. Brown's name is not among the identified sources though the omission may not be significant; there are several examples in the Waste Books of Stokes's donations with no comment as to the collector. The case for Robert Brown as the source of the original *Trigonotreta* really rests on the knowledge that he did find shelly fossils near Hobart (in what he called 'marl' and Humphrey an 'argillaceous stone'), that he brought samples home with him and gave some at least to Buckland. Stokes and Brown were also friends, so Brown could have given him specimens. We do not know; the Stokes–Brown correspondence in the Botany Library (BM (NH)) yields no clues. The common view is no more than possible. Indeed, the arguments of Brown (1946; 1953) in favour of Brown as the collector of *Trigonotreta* have difficult aspects. Not only is Stokes's gift of May 1821 a doubtful link on lithological grounds but Buckland's (1821) reference to fossils from a hill south of Table Mountain need not be a hint to Brown's collecting locality. Buckland (1821) dealt with Brown's fossils and also with the collections from the Oxley explorations. It will be remembered that Oxley and Youl were connected in Stokes's gift of June 1821. And in Youl's catalogue no. 46 (17792 in the old Geological Society collection) is described as 'Petrefactions from a hill South of the Table Mountain'. A mark against the entry suggests it was among the residue transferred to the British Museum in 1911. With that single exception, the pieces are now held by the Department of Mineralogy (BM (NH)), registered under 1911,1579. It may be added that a productid brachiopod from Austin's Ferry on the Derwent River is among them. Search in the Department of Palaeontology at the museum, however, has failed to find Youl's no. 46. The search should be continued, for the possibility that Youl, not Brown, supplied the first *Trigonotreta* cannot be ignored.

No matter whether Brown or Youl's supplier or someone else collected *Trigonotreta* from Tasmania, Brown had discovered fossils there and in New South Wales and by passing samples to his friend Buckland helped take the first steps towards elucidation of Australian palaeontological stratigraphy. If Brown's role in that business was somewhat accidental, the *Investigator* expedition had provided a means. This was a case where the sort of collecting recommended by Banks could be useful. But Banks's notion that mere gathering of samples in general would suffice led to weakness in the geological achievement. Rock samples alone can give few insights into the important field of relationships between strata. Neither Flinders nor Brown achieved much more than a limited lithological survey—what Hawkins, in his *Instructions*, called mineral geography. To say that is not to criticize them; they amply satisfied their commission. And in fairness it must be added that a considerable body of scientific opinion then still held to the concept that lithological characters alone were an adequate basis for correlation of strata. The idea had arisen from observed positional relationships between strata in Europe and developed through a notion of world-wide formations into a method of lithological stratigraphy.

Positional observations and lithological characters were used by Baudin's mineralogists to discern stratigraphical order in Australia. Leopold von Buch (1814) had sought system in the samples they brought back, and admitted puzzlement. Perhaps the idea of universal formations

was not as infallible as Buch had once thought. But Buch's incisive attention moved to other matters and the Paris collections were forgotten. His doubts were not shared by Fitton in his study (King, 1826) which embraced some of Brown's rocks. In 1826, the lithological approach was being strongly challenged by stratigraphical method dependent on palaeontological evidence. Fitton knew this but, having no fossils, adopted the old lithological scheme. As Brown had no positional detail to offer, Fitton tried to find order in a random collection of rock samples. Fitton's analysis is less impressive than that of Buch more than a decade earlier.

Fitton's lithological comments, however, are worthy of note. The fashion for describing collections of rock samples brought back by explorers was relatively new. In 1818 Konig supplied descriptions of rocks from Zaire, made available by the Admiralty. The parallels and contrasts with the *Investigator* voyage are interesting. That expedition to the River Zaire was led by J. K. Tuckey (1776–1816), who had been with Collins at Port Phillip in 1803, and in Hobart at the time Brown was there. Tuckey had suffered imprisonment by the French even longer than Flinders and was to die a victim of his zeal for exploration. But the rocks gathered on that African expedition not only passed from the Admiralty to the British Museum, they went with a request that they be studied. Konig's report in answer to the request forms an appendix to Tuckey's account (Tuckey, 1818, Appendix VI). Konig had been at the museum when the *Investigator* rocks arrived and succeeded to the keepership of the then Department of Natural History in 1813. Banks's sanguine belief in January 1806 that the officers of the British Museum were fully competent to arrange the collection of minerals may have been justified but it bore no fruit. Flinders was to publish his record of the voyage with only a botanical appendix by Brown. The geological contributions, tucked away in the text, were Flinders's own. For what was done on the collections, Brown had to take the initiative and by then he was fully occupied by botany. Apart from that science, the interests of natural history in the context of the *Investigator* expedition were ill-served, not by those who travelled but by those in London who failed to give adequate support before and afterwards. That there are geological results to consider stems chiefly from the enthusiasm of Matthew Flinders and the occasional attention of Robert Brown.

Acknowledgements

Thanks are due to Mr S. R. Band and Dr T. D. Ford for advice relating to Derbyshire, to Dr C. H. C. Brunton for help with palaeontological matters, to Miss P. I. Edwards for making available her transcript of the Good diary, Mr J. G. Francis for X-ray diffraction studies and Mr H. P. Powell for granting us access to the Oxford collections. We are grateful, too, for the generous help afforded by the staff of the Department of Library Services in the British Museum (Natural History). Mrs E. V. Brunton (Mineralogy Library, BM (NH)) secured for us copies of the Allen papers in the Sutro Library, San Francisco. The senior author wishes to place on record his debt to the Keeper of Minerals, Dr A. C. Bishop, and his staff for splendid hospitality during the period of study-leave from the University of Sydney when this work on the expedition-collection was carried out.

Abbreviations Used

BL Add MS	British Library, London. Additional Manuscripts.
BM (NH) DTC	British Museum (Natural History), Dawson Turner Copies. (Botany Library).
HR A	*Historical Records of Australia.* (Sydney, Government Printer. 1914–1925).
HR NSW	*Historical Records of New South Wales.* (Sydney, Government Printer. 1892–1901).

References

Beaglehole, J. C. (Ed) 1955. *The Journals of Captain James Cook on his voyages of discovery. The Voyage of the* Endeavour *1768–1771.* Hakluyt Society, Cambridge.

——1962. *The* Endeavour *Journal of Joseph Banks 1768–1771.* 2 vols. Publ. Lib. N.S.W. and Angus Robertson, Sydney.

Brongniart, A. 1828. *Prodrome d'une histoire des végétaux fossiles.* F. G. Levrault, Paris.
——1828–38. *Histoire des Végétaux fossiles ou recherches botaniques et géologiques.* Bocage & D'Ocagne, Paris and Amsterdam.
Brown, I. A. 1946. An outline of the history of palaeontology in Australia. *Proc. Linn. Soc. N.S.W.* **71**: v–xviii.
——1953 (for 1952). Permian spirifers from Tasmania. *J. Proc. R. Soc. N.S.W.* **86**; 55–63.
Buch, L. von, 1814. Einige Bemerkungen über die geognostische Constitution von Van Diemens Land. *Magazin Ges. naturf. Fr. Berl.* Jg. 6: 234–40.
Buckland, W. 1821. Notice on the geological structure of a part of the island of Madagascar, founded on a collection transmitted to the Rt. Hon. Earl Bathurst, by Governor Farquhar in the year 1819; *Trans. geol. Soc. Lond.* (1st ser.) **5**: 476–81.
Burbidge, N. T. 1956. Robert Brown's collecting localities. *Proc. Linn. Soc. N.S.W.* **80**; 229–233.
Cuvier, G. 1822. *Essay on the theory of the earth. With mineralogical illustrations* by Professor Jameson. William Blackwood, Edinburgh.
——1825. *Recherches sur les ossemens fossiles* ... 3rd edn., 5 vols. Dufour & D'Ocagne, Paris.
Dampier, W. 1703. *A voyage to New Holland ... in the year 1699.* James Knapton, London.
Darwin, C. 1842. *The structure and distribution of coral reefs.* Smith, Elder & Co., London.
——1844. *Geological observations on the volcanic islands, visited during the voyage of H.M.S. Beagle.* Smith, Elder & Co., London.
Edwards, P. I. 1976. Robert Brown (1773–1858) and the natural history of Matthew Flinders's voyage in H.M.S. *Investigator* 1801–1805. *J. Soc. Biblphy nat. Hist.* **7**: 385–407.
Flinders, M. 1810. Sur le Banc du Naufrage et sur le sort de M. de la Pérouse. *Annales des Voyages, de la Géographie et de l'Histoire,* **10**: 88–108.
——1814. *A voyage to Terra Australis ... in the years 1801, 1802, and 1803, in His Majesty's ship the Investigator* ... 2 vols. and atlas. G. and W. Nicol, London.
Forster, J. R. 1778. *Observations made during a voyage round the world* ... G. Robinson, London.
Harris, H. D. 1974. John Allen. *Camborne Festival Magazine.* Nov. 1974. pp 19–23.
Jameson, R. 1811. On the topaz of Scotland. *Mem. Wernerian nat. Hist. soc.* **1**: 445–52.
Jukes, J. B. 1847. *Narrative of the surveying voyage of H.M.S.* Fly ... 2 vols. T. and W. Boone, London.
King, P. P. 1826. *Narrative of a survey of the intertropical and western coasts of Australia, performed between the years 1818 and 1822.* 2 vols. John Murray, London.
Konig, C. 1825. *Icones Fossilium Sectiles.* London.
Labillardière, J. J. H. de 1800. *Voyage in search of La Perouse ... during the years 1791 ... 1794.* 2 vols. John Stockdale, London.
Péron, F. 1804. Sur quelques faits zoologiques applicables a la théorie du globe. *J. Phys. Chim. Hist. nat.* **59**: 463–79.
Péron, F. and Freycinet, L. 1816. *Voyage de découvertes aux Terres Australes ... Historique.* Tome 2. Imprimerie Impériale, Paris.
Russell, Sir A. 1950. John Henry Heuland. *Mineralog. Mag.* **29**: 395–405.
Scott, H. W. (Ed) 1966. *Lectures in geology ... by John Walker.* Univ. of Chicago Press, Chicago.
Smith, W. Campbell. 1969. A history of the first hundred years of the mineral collection in the British Museum with particular reference to the work of Charles Konig. *Bull. Br. Mus. nat. Hist. (Hist. ser).* **3**: 237–59.
[Thomson, T.] 1814. Topaz. *Ann. Phil.* **4**: 472.
Tuckey, J. K. 1818. *Narrative of an expedition to explore the River Zaire, usually called the Congo, in South Africa, in 1816.* John Murray, London.
Vallance, T. G. 1975. Origins of Australian geology. *Proc. Linn. Soc. N.S.W.* **100**: 13–43.
——1978. Pioneers and leaders—a record of Australian palaeontology in the nineteenth century. *Alcheringa,* **2**: 243–250.
——1981. The start of government science in Australia: A. W. H. Humphrey, His Majesty's Mineralogist in New South Wales, 1803–12. *Proc. Linn. Soc. N.S.W.* **105**: 107–46.
Vancouver, G. 1798. *A voyage of discovery to the north Pacific Ocean and round the world* ... 3 vols. G. G. and J. Robinson, London.
Whitehead, P. J. P. 1973. Some further notes on Jacob Forster (1739–1806) mineral collector and dealer. *Mineralog. Mag.* **39**: 361–3.
Woodward, H. B. 1907. *The history of the Geological Society of London.* Geological Society, London.

Appendix

John Hawkins's Geological *Instructions* for Robert Brown (BL Add MS 32439 ff 33–40)

Original spellings and arrangement are preserved in this transcript. The document is neither signed nor dated and, apart from Brown's addition *M^r Hawkins' Instructions* on the verso of f. 40, there are no annotations. Comparison of the handwriting with that of letters by John Hawkins at the BM (NH) and elsewhere makes it clear that he was responsible for the holograph manuscript.

In a voyage of so much scientifical interest as that which is about to be undertaken to the South Seas it would be wrong not to pay some attention to Mineralogy; at the same time it must be confest that this department of Natural History promises fewer discoveries than the two others which are more particularly the objects of the expedition.

For not to mention the want of a good practical Observer in this line, among the men of Science who have been selected for this voyage, the means of observing are fewer, more leisure is required for making discoveries and there are much greater physical impediments to the acquisition of knowledge.

The countries which are likely to be visited, are for the most part overgrown with wood, difficult of access and if inhabited, insecure. The Mineralogist therefore can only form a judgement of the nature of their constituent strata and of their productions from the natural sections of these strata which are exposed in the cliffs & ravines near the Sea or from the alluvial contents of the river beds or from the substances rejected by the tides on the shore.

The means of observation being so limited, the information thus obtained will necessarily prove less conclusive & important than could be wish'd; nevertheless it will be both usefull and acceptable if made with an attention to accuracy and method.

The following hints, it is presumed, may serve to direct and facilitate such enquiries.

Distant sea views of Islands & Continents as they present a general idea of their rise [,] elevation and vertical outline, ought to be correctly delineated not merely for the information of the Geologist, but for the advantage of the Navigator.

On a nearer approach, the more particular features of this outline unfold themselves. The mass of high ground then gradually divides itself into ridges, which successively develope their distinct features and arrange themselves under a proportional scale of heights, the highest ridge being most probably at the greatest distance from the sea shore.

This different aspect of the country must be marked by an accurate drawing.

Mountains of a volcanic origin may be distinguished at a great distance by their invariable tendency to assume a conical form, by their insulated position in respect to other mountains which are usually connected together in the form of ridges, by the smoke which they emit and by the general redness of their tints.

Mountains of this description abound in curious subjects for drawings, but those which are selected by the Naturalist are not in general such as would satisfy the Artist or the Connoisseur for they are not the most picturesque.

The points of view which are most characteristical of the volcanic phoenomena will be chosen as indeed they ought to be for a voyage which is devoted to the purposes of Science and the Artist must submit, however reluctantly, to delineate objects which will certainly not exhibit his talents to the best advantage. He must be guided in fact in their selection by the man of Science and must consider the accuracy of his portrait as the greatest test of its merit, avoiding every thing like picturesque embellishment.

Mountains too which are not volcanic and the natural sections of the strata on the Sea-shore will frequently afford very interesting subjects for geological drawings.

For the forms of hills & mountains are often characteristical of the strata which compose them and sometimes they expose to view their constituent strata.

Both the distant and the near views which are taken of every new land, will furnish a very adequate idea of the form of its superficies, but if description is to be employed in aid of delineation, it will be difficult to avoid incongruity for it is mortifying to observe that the

language of geological description is not yet formed or fixed, insomuch that nothing can be more vague and indeterminate than what has been hitherto used for that purpose by Travellers & Naturalists. Not only the terms are confounded but the order inversed too in which they ought to be applied, in consequence of which no clear ideas are presented to the mind and no information.

Travellers indeed more frequently belong to the class of picturesque than of geological observers and their descriptions of the face of a country relate more to its effects on the eye than to its structure and composition; but in a voyage like this, it is presumed that the latter will be thought a much superior object of curiosity to the former and will almost exclusively occupy the attention of the Journalist.

The natural order of things, so far at least as they are objects of sensation, will suggest that which ought to be pursued in his description. The great and the general features are to be seized first, Let him descend by degrees to the particular ones and dwell chiefly upon such as are the most characteristical.

After describing the face of a country, that is, the form of its superficies and even its verdure or sterility; let him state what he has been able to observe of its constituent strata and what he is authorized to conclude from analogy.

It has been already remarked that the forms of mountains are influenced by the nature of their constituent strata, and although this rule is more particularly applicable to some strata than to others and requires a practised eye it will be found of great service in assisting enquiries of this nature, especially in countries so difficult of access.

It may be proper, in this place, to cite some examples of these modifications of the forms of mountains. The volcanic have been already mentioned, they are perhaps the easiest of all others to recognize and next to these the Whinstone or Basaltic, which from the peculiarity of their profile in some countries are termed Step mountains. These are often insulated & conical but have always a truncated summit. Hills or mountains of Sandstone present at a moderate distance a convulsed grotesque appearance.

Calcareous mountains are broken into vast chasms, abound in declivities & caverns and may be farther distinguish'd by their tint. There are no mountains altogether so picturesque as these. Most of the great Chains which traverse Europe are chiefly composed of calcareous Strata.

Mountains of Granit, Gneiss & Micaceous Slate have less boldness of character and more uniformity.

The first rarely occur in ridges and present not often unequivocal marks of a regular stratification. The rock however divides into vast masses which are exposed on various parts of the surface and may be distinguish'd by their grotesque appearance at a distance.

Mountains of Gneiss & Micaceous Slate are not only regularly stratified, for they frequently alternate with strata of granular marble, but the Strata divide into thin Lamellae which gives a shattered & shivery appearance to their declivities. Mountains of Argillaceous Slate participate of these external characters, but are much more favourable to vegetation.

It is necessary to remark that the term Mountain is not used here in its most limited Sense.

The study of the characteristical forms of mountains in relation to the strata which they contain is usefull moreover to the Navigator as well as the Geologist by pointing out those situations where he is most likely to find water. Calcareous mountains for instance are remarkable for the paucity of their springs and for the saline nature of them, but mountains of Gneiss[,] Micaceous Slate and Argillaceous Slate abound at every stage of their elevation in sources of the purest water. Calcareous mountains too discharge their collected water from a few situations at their bases, usually at no great distance from the sea and generally on a level with it. Volcanic countries are still more destitute of springs of potable water than even calcareous.

On a nearer view of the strata of mountains other characters occur, which point out the nature and value of their contents & the utility of farther research.
Some for instance are metalliferous & others not.

There are some which are observed to contain only a limited number of the known metallic substances and there are some metallic substances which are found in certain strata only.

Precious stones too are probably generated in some peculiar rocks, of which in some instances

they are known to form a constituent part. We may add to these observations that certain Strata point out in an infallible manner the vicinity of Coal, Rock Salt, Alum and other valuable mineral substances. Nevertheless, the Strata which are productive of Metals are by no means in every situation of the Globe equally metalliferous. Granit for instance and calcareous Strata are generally destitute of metallic contents.

Again, the more recently formed Strata seldom contain the noble metals, unless it be in an alluvial state, which is the result of accident. As for the value of a newly discovered country abounding in metals or precious stones; that will depend upon the facility of Colonization upon the favourable circumstances of the ground in respect to mining labour & machinery and upon the abundance of timber and fuel.

The most flattering indications of Metals however often prove fallacious.

It may be usefull to remark in this place that certain metals are always found in their perfect state and others always oxydated or mineralized; many however are found both in the one state and the other.

Also, that some metals are found only in the situations where they were generated and that others are equally found in situations where they have been removed by accident.

The first metal known to unpolish'd nations, is Copper, not because it is the most abundant, but because in a pure state it more often occurs than any other and in situations perhaps more accessible.

The next is Gold, which is easily collected by the inhabitants of many unpolish'd countries in the beds of torrents & rivers when exposed by the heavy falls of rain.

An effort of Art & much Labour were required to reduce Iron to a state fit for use. It appears therefore to have laid long unknown and neglected. Gold & Copper then are the only metals which are likely to be found in the possession of the natives of those countries which will be visited but more generally their use is supplied by hard stones which the natives have found the means of shaping into instruments of war and of fashioning into ornaments of dress. A sort of Lava is applied by the South Sea islanders to the former and Jade to the latter. The precious stones if known to them are neglected on account of their diminutive size and perhaps on account of the impossibility of perforating such hard bodies.

In countries so remote and uncivilized, Discoveries of this kind are not likely to be of much utility and are chiefly interesting to the Geologist who is desirous of learning whether the mineral productions of that extremity of the Globe are analogous to those of our own and how far in respect to the mineral kingdom Nature has been uniform or capricious in her operations.

It is this point of view which ought particularly to be chosen by the Scientifical Gentlemen who are employed in this expedition. The Task assigned to them being Mineralogical Geography. After an accurate description & delineation of the face of the countries which they visit they will be required to give us some account of their constituent Strata, so far at least as the opportunities which they shall have for information, will admit of.

A collection of well chosen specimens too, will be considered as indispensibly necessary for the correction & confirmation of their observations.

In the process of observing, a variety of circumstances deserve to be noted which those who are little versed in the Science of Geology may neglect from their apparent unimportance and which those who are not in the habit of observing may overlook. It will be usefull therefore to state what these circumstances are.

Ridges of Mountains are observed to be composed of very different Strata from those which constitute the intermediate Plains.

The Strata in each seperate chain of non-volcanic Mountains follow each other in a certain order.

This order must be traced and investigated. If the bulk of elevated ground is considerable, it will be found to consist of a central ridge and of one or more parralel and subordinate ridges which are easily discriminated by their forms and by their constituent Strata.

The exterior or lowermost ridge usually consists of the more recently formed Strata, the next in succession of the metalliferous and the third or central ridge of the oldest which are often

granitical. But these three will be more or less mixed; the strata of the second ridge for instance will often be found imposed on those of the central and the strata of the first ridge on those of the second.

These observations however are applicable only to such large chains of mountains as cheifly determine the forms of countries, for the smaller chains which intersect them are by no means so composite.

Nor is it to be inferred from what has been said of the larger chains, that the oldest Strata are constantly to be met with in the most elevated positions; on the contrary, they often constitute the basis of maritime countries & islands. Elevation therefore is no just Criterion of the relative age of the Strata but Infraposition.

For that which is subjacent to every other stratified mass must be the oldest and that which covers every other must be the most recent. As the Mountains (even the Granitical) are stratified, it is easy to ascertain how far the Strata have been moved out of their original horizontal position.

In general they are observed to rise and fall towards the central ridge to which they appertain, but in no very uniform manner. It will be usefull to attend very particularly to this fact.

To this inclination of the Strata and their necessary disruption we are principally indebted for the means of exploring their contents and their relative position. The principal Vales owe probably their origin to such revolutions. If a portion of mountainous country so circumstanced be very regularly stratified the strata will shew both the degree and the direction of their inclination in the general form of the superficies, but some mountains have such an irregular & imperfect stratification that no Criterion of this sort can be taken from them.

The most instructive examples in this way are furnish'd by the compound stratified mountains, some of which will probably occur in the course of the voyage.

It is owing to the changes which have taken place at very remote periods, in the form and arrangement of the Strata and to the subsequent operation of floods that we find their fractured contents removed to such a distance in the beds of rivers and in the soil of vallies the inspection of which may be considered as the first preliminary step to a knowledge of the constituent Strata of a country.

To these situations above every other, in the onset of his enquiries, the traveller is referr'd for Geological information. They will be found singularly instructive in regard to the productions of those parts of the interior which he has not the means of visiting.

The discovery of precious stones and of metallic substances must cheifly be expected in such situations. Of the latter, the most prevalent are Tin & Gold. All these may be detected by their specific gravity and therefore will be found collected in the lowest beds of these alluvial depositions. The force of torrents indeed often expose them but more generally they are discovered in mining countries by regular excavations. The more valuable parts of the sand are then extracted by Elutrition, the particles subsiding in the water according to their proportionate size and their specific Gravity: but much depends upon the dexterity with which this operation is conducted and on the impliments that are made use of for this purpose.

If the Gentlemen who are employed in this expedition had been more in the habit of pursuing these enquiries, a much greater variety of important matter might be pointed out to their attention and many more usefull hints might be given for directing their observations.

It remains now for the writer to give a few instructions for collecting specimens of the mineral productions of these new countries, a point of the utmost importance in respect to the verification of the discoveries which will be made in this line.

In the composition of the sand or the shingle of the sea beach will be found the more indurated contents of the neighbouring Strata, which although worn smooth by attrition are not to be rejected unless better specimens can be obtained from their native beds.

The substances more commonly found in such situations are Agates[,] Jaspers[,] Calcedonys and Quarz.

From the inspection of the Sea beach some judgement may be formed of the contents of the neighbouring cliffs & hills.

The Cliffs present the most striking and instructive Phoenomena. The metallic substances are often exposed there to view in their native beds or veins.

In the choice of specimens both of the rock and of the substances which it encloses, care must be taken to select such as shew the characters by which they are distinguish'd, in their most perfect state. They must be taken therefore from the more solid & undecayed parts of the mass and must be sufficiently numerous to exhibit all the varieties of grain[,] form and colour. The most convenient size & shape is an oblong of the dimensions of a mans hand and nearly of the same thickness.

Immediately after being broken off they ought to be protected from the moisture of the hand and enveloped in paper, numbered & deposited in a barril. The numbers are to be continued until the barril is full when the barril too is numbered or lettered.

The numbers on the papered specimens refer to a short catalogue which records the places where the specimens were found together with such circumstances immediately connected with them as are thought worthy of being subjoined, but as for any general information on this subject it must be drawn up in a seperate form after the country has been more fully investigated and the dispersed local information acquired in repeated excursions has been collected into a Focus.

The Miner who will regularly attend the party upon these occasions must be employed in breaking the specimens with his Sledge hammer and in carrying them in a large leathern pocket appendant like a Gamekeepers bag to his side. It is hoped that he will generally be pretty well loaded.

If the specimens are well chosen, that is, if they are of the form above prescribed, taken from the more solid parts of the rock exhibiting a fresh fracture on all sides, unsullied by the touch, every object of their collection will be attained, but if these circumstances from their apparent triviality are not carefully attended to, the labour bestowed on the collection will be of little utility.

Manuscript submitted for publication 2 November 1978